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# HIGHLIGHTS THIS MONTH

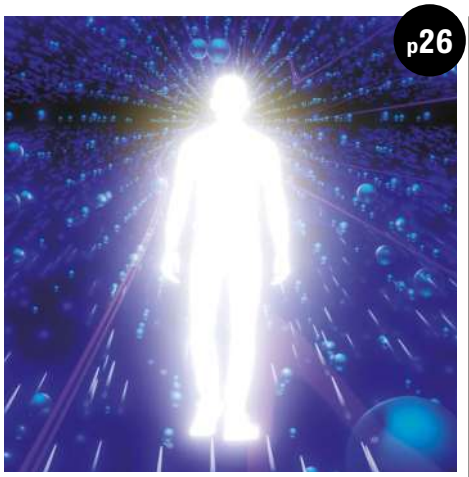
Full contents overleaf

p48

## REVIEW OF THE MONTH

### The £7,000 PC

Look, we know that you're unlikely to whip out your credit card and buy the Chillblast Poseidon. But we still love it, and here's why: one, it looks absolutely stunning. We've done our best to give it due credit in a three-page review, but sometimes photos only go so far. Two, it goes like the clappers. As it should, with the Ryzen 9 9950X3D processor and Nvidia GeForce RTX 5090 graphics both benefiting from liquid cooling. Naturally it's supported with a luxurious cast of motherboard and 4TB SSD, while Chillblast will service it each year for three years as part of the price. Turn to p48 for our full verdict.



p26

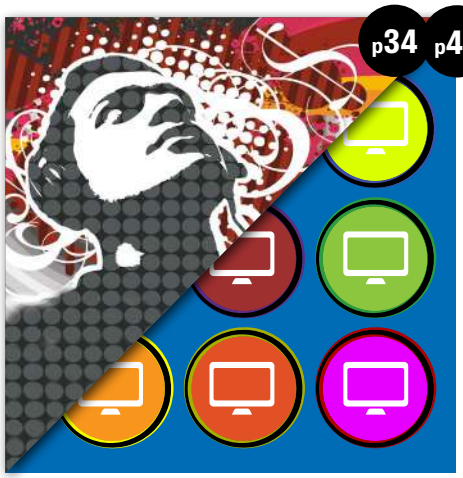
## ETHICAL QUANDARY OF THE MONTH

Keeping loved ones' memories alive is a complicated task, but a new breed of AI companies aim to do so with digital facsimiles. We explore the ethics and the practicalities.

p38

## PRACTICAL TIPS OF THE MONTH

If you're anything like us, you've come to rely on Google Docs and Sheets as part of your daily lives, but are you using them to the max? We reveal their hidden talents.



p34 p42

## DOUBLE DEEP DIVES OF THE MONTH

Not only do we reveal why Auracast is such an interesting audio technology on p34, we also delve deep into display technology from p42.

p12

## INTERVIEW OF THE MONTH

### Philip Young

Here's a less controversial use of AI: using it to make small claims in the courts without the expense and time-consuming hassle of lawyers. In this exclusive interview, Philip Young explains the thinking behind Garfield AI.

p76

## THE LABS IN ONE NUMBER

You no longer need to spend a fortune to buy a high-quality laptop, and many now come with AI built in thanks to affordable Copilot+ PCs and Chromebook Plus devices. We put a dozen to the test.

PC PRO

# Make yourself immortal with AI

p26

FREE SOFTWARE WORTH £153 See page 64

BUILD YOUR OWN GRIEFBOT See page 32

p76

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LATEST REVIEWS

## Microsoft 12in Surface Pro

It's bigger, but is it better?

p56

## Microsoft Surface Laptop 13

Ultra-portable, ultra-sleek

p54

## Real World Computing

**110 Jon Honeyball**
Something's got Jon's goat this month, and it's not his Vision Pro.

**113 Lee Grant**
A customer is asked to perform unspeakable horrors on an innocent mouse.

**116 Olivia Whitcroft**
An invitation to a child's birthday party makes Olivia consider being a party-pooper.

**118 Davey Winder**
Davey analyses the recent ransomware attacks on high-profile UK companies.

**120 Steve Cassidy**
In defence of IT staff and hacks.

BELOW Wi-Fi 7 finally lives up to the hype: p110

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## REGULARS

7 Editor's letter
14 The A-List
24 Readers' letters
108 Subscriptions
129 Next month
130 One last thing...

## BRIEFING

**10 Gigabit Britain deadline pushed back**
Uncertainty rises over how and when to reach those without fibre.

**11 Open-source firms stir up Windows 10 backlash**
EndOf10 campaign highlights free Windows alternatives.

**12 Interview: Philip Young, Garfield AI**
We talk to the man behind the AI law firm that handles small claims court paperwork for you.

## VIEWPOINTS

**20 Dick Pountain**
Scientists have discovered a new colour. Let's hope that, unlike sci-fi stories, it won't turn the world into ash.

**21 Nicole Kobie**
The way we work has changed. It's time the rest of society caught up.

**22 Barry Collins**
With so much money in the bank, it's time for Apple to find another visionary for its next CEO.

## FEATURES

**26 You and AI are gonna live forever**
AI is offering people a shot at digital immortality. Barry Collins investigates where it might all lead.

**34 Auracast: Bluetooth, but better**
It means an end to garbled station announcements and enables deaf people to return to the theatre. Phil Creighton explains the latest Bluetooth standard.

**38 Google Docs and Sheets' hidden features**
There's more to Google's free online apps than meets the eye. Nik Rawlinson explores their advanced capabilities.

**42 Instant Expert: Displays**
Darien Graham-Smith takes a close look at the specs and capabilities that allow the best screens to shine.

## THE NETWORK

**106 Inventory management**
Your stock, and the data pertaining to it, are crucial business assets. Steve Cassidy shares the challenges of managing them.

## REVIEWS THIS MONTH


**DESKTOP PCs**
48 Chillblast Poseidon Ryzen 9 RTX 5090 Water Cooled Gaming PC
51 PCSpecialist Frostbyte Elite

**LAPTOPS & CONVERTIBLES**
54 Microsoft Surface Laptop, 13-inch
56 Microsoft Surface Pro, 12-inch
58 Alienware 16 Area-51
60 Asus ProArt P16 (2025)
82 Acer Swift 14 AI
83 Asus Vivobook S15
84 Asus Zenbook A14
86 Dell 14 Plus
87 HP OmniBook Ultra 14
88 Lenovo Yoga Slim 7x
89 Samsung Galaxy Chromebook Plus
90 Acer Chromebook Plus 514
90 Acer Chromebook Plus 516
91 Acer Chromebook Spin 312
92 HP Chromebook Plus x360
92 MSI Modern 15 F1MG

**TABLETS**
62 OnePlus Pad 3
66 Samsung Galaxy Tab S10 FE+

**KEYBOARDS & MICE**
68 Dell Pro Compact Silent Keyboard and Mouse (KM555)
69 Dell Pro Wired Collaboration Keyboard (KB525C)
69 Logitech Slim Wired Combo MK620 for Business

**WI-FI 7 ROUTERS**
70 Asus RT-BE58U
70 TP-Link Archer BE550

**SMARTPHONES**
72 Honor 400
73 Honor 400 Pro
74 Motorola Edge 60 Pro
75 Samsung Galaxy S25 Edge

**CLOUD BACKUP**
98 BackupVault Enterprise Server Edition
99 Barracuda Backup Vx
100 IDrive Business
101 Synology C2 Backup for Business

**WIRELESS ACCESS POINT**
102 TP-Link Omada EAP725-Wall

**PORTABLE NAS**
103 UnifyDrive UT2


p54 **It's great value, but has Microsoft's 12in Surface Pro got what it takes to compete with the best?**

## LABS

p76

# EVERYDAY LAPTOPS

Whether you're after a Chromebook or a Windows system, one of these dozen bargain-priced laptops should meet your needs.

## Buyer's guide

**96 Cloud backup**
From synchronisation to ransomware protection, it makes sense to play it safe when choosing a cloud backup solution.


## Retro

**123 Enter the Dragon**
It entered with a roar and left with barely any fire in its belly, but there's no doubt Dragon's computers ought to be celebrated, says David Crookes.

## Futures


**126 Idioms and AI**
The elephant in the room is that AI can't recognise idioms. Nicole Kobie explains why you can't lick a badger twice when it comes to expressions.

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# The mobile web is broken and I know how to fix it

Damn, I did it again. Clicked on a link without thinking, one that sucked me into the hell-hole that is a modern-day mobile website. Like a tug-of-war we can never escape, we're constantly dragged along by clever headlines designed to create an itch that we suddenly need to scratch. "Celebrity A shares their secret feelings about Celebrity B", it goes, and because we're all such drones – half-asleep, bored, intrigued – we click it.

And then we land on the site to be met with a double dose of awfulness. First, an article that has been written with the juicy nuggets – if there are any – only revealed several scrolls down the page. Second, to get there, bold adventurer that you are, you must vanquish the pop-up ad, negotiate the skin, slay your way through countless videos in which you have zero interest. Do not click, my friend, or forever be chased by demon monsters powered by cookies.

"Something must be done!" comes the cry. And so politicians have the amazing idea that every time you need to visit a website you must click to accept the cookies. Brilliant! Thanks, chaps. One more button to press, one more screen to negotiate, before I reach my final destination. But, hey, it's great to know that all these lovely companies care about my privacy. They and their 61 affiliate partners.

Now we have yet another foe to defeat: AI. I'm not suggesting that Google's AI Overview – other AI-enhanced search services are available – hasn't come to my aid on occasion, but there was a glorious time when I could perform a search and see what I needed *without* scrolling past a pile of dross. Now I must flick past AI Overview and a bunch of sponsored ads to get anywhere close to where I wanted to be.

Perhaps one day we will look back at even these as halcyon days. In May, Google didn't just give us a glimpse of the future but shoulder-barged an entire country into it: its "AI Mode" is now foisted on all US users, with the idea being that you'll chat to it as you might a friend. Due to the wonders of VPNs I've given it a whirl and yes, sure, it's fine. If you like bland, boring and irritating people who constantly respond to questions with "well this is what others think but I couldn't possibly say".

I don't think AI is the answer. Not least because it uses so many resources that tech companies are buying up nuclear power stations. Instead, it's trust. Backing the brands that you believe in, the ones that don't blind your retinas with pop-up ads. It means paying money to subscribe. And sometimes, just sometimes, putting your phone away and chatting to friends. Annoying ones who disagree with you but who actually have opinions.

Most of all, it means not clicking on that link. But what's that, Andy Murray shares his secret feelings about working with Djokovic? Damn, I did it again.

**Tim Danton**
**Editor-in-chief**


**PC Pro needs your help!**

**Who will win this year's *PC Pro* Excellence Awards? Only you can tell us, so you'd better share your views to find out!**

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**This month's lead feature (*see p26*) explores the ethics of turning memories into digital avatars that loved ones can chat with. Do you think such "griefbots" are a good idea?**

**"Controversially, I'm going to say yes. Obviously about a billion caveats apply, but how amazing would it be to interact with ancestors from a century, two centuries ago? Of course it's a facsimile, it won't be the real thing, but humans are clever enough to realise that."**

**"I think griefbots are a terrible idea and therefore inevitable. I predict it will also be possible to rent a griefbot of *yourself*, for those on the neuro-psychodepressive spectrum, and there'll be an affordable accommodation infrastructure based on the technology of those Japanese commuter 'capsule hotels'. For full energy efficiency, should your life-signs become suboptimal they will cremate you in situ."**

**"Sounds ghoulish to me. I would normally say 'I suppose it's backed up by some sort of research', but this being Silicon Valley I doubt it."**

**"Of all the technologies I've written about in the past 28 years, I'm struggling to think of a worse idea."**

**"Nope. Grief and loss are difficult emotions to deal with, but refusing to confront them is probably counterproductive in the long term (untrained non-psychiatrist talking here). I'd much rather remember lost friends and relatives as they were when still in the physical world."**

**"I imagine there are benefits to a generic Electric Budgerigar as a chatty companion, but pseudo-replicants of loved ones seems like a gateway for vulnerable people to be scammed, misled, exploited and emotionally traumatised. I doubt charlatans imbuing Ouija boards with AI will genuinely benefit many grieving people."**

**"Horrifying."**

**"I'm all for memorialising our loved ones, but this is mimicry. You're literally putting words into your loved ones' mouths. It feels like such an intrusion into their autonomy and personhood that expired with them when they died. The fact is that death is something we need to process. Replacing real memories with AI-generated distortions risks isolating the bereaved if they go down this rabbit hole, deluding themselves with a tool that is not their loved one. Contributing further to their sorrow. In a world of bad ideas, this is a league ahead of other bad ideas. Just no."**

**"I agree with Lee: the opportunities for criminal exploitation outweigh any (perceived) benefit."**

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# Briefing

Background and analysis on all the important news stories

# Gigabit Britain deadline pushed back

**Uncertainty rises over how and when to reach those without fibre**

The government has quietly pushed back the target to reach the whole of the UK with gigabit broadband, creating uncertainty for those not yet reached by full-fibre networks.

The government's Project Gigabit previously aimed to ensure almost everyone would have access to gigabit broadband by 2030. The recent spending review saw that target moved to 2032, although the £1.9 billion of funding remains, just spread over a longer timeframe.

The spending review document (**tinyurl.com/371spending**) says the money will be used to connect "more homes and businesses to gigabit-capable broadband to reach 99% of UK premises by 2032" as well as "working with industry to deliver the Shared Rural Network so the most remote areas have 4G coverage".

A government spokesperson told *PC Pro*: "Fast, reliable internet is essential to boosting the economy in every part of the UK, which is why achieving the target of 99% gigabit coverage across the country remains a priority.

"The timeline has been adjusted to 2032 as we stabilise the challenging fiscal and economic situation we've inherited. We maintain a strong partnership with industry to deliver the fibre rollout as well as a competitive regulatory environment that stimulates the private investment needed to connect communities across Britain."

## Inevitable delay

Paddy Paddison, chair of the Independent Network Cooperative Association (INCA), which represents many of the smaller, "altnet" fibre providers, said the news is "not as bad as it could have been".

"It's great that they kept the focus on completing it," he said. "The concern was obviously that they would try and claw back money from it, and they haven't. So that commitment to 99% still stands."

Industry watcher Andrew Ferguson thinks the government's announcement is not so much a spending cut, more of a reflection of how much work there is still to do to reach the remaining areas.

> "The option is stick to the target that looks all great and then miss it... or be pragmatic and go, look, we're going to have to shift the target a little bit"

"They've looked at the market, they've looked at the data from their open market reviews, and the commercial picture has changed a little," said Ferguson, editor-in-chief of Thinkbroadband.com. "There's

been some issue with a few of the Project Gigabit contracts.

"So, the option is stick to the target that looks all great and then miss it... or be pragmatic and go, look, we're going to have to shift the target a little bit. Yes, two years is a long time if you're waiting. But that's realistically where they think it is at the moment," Ferguson added.

Ofcom's most recent forecast suggested that between 97 and 98% of UK premises should have access to gigabit broadband by the middle of 2027. But it's that final few per cent of the country that is the most challenging to reach, either because they are in rural areas where it's economically challenging to lay fibre to the door, or because of peculiar circumstances that meant a property wasn't reached when an area was first connected to fibre.

Ferguson gives an example of how people even in the heart of the biggest cities can sometimes be excluded from fibre rollouts, such as a seven-floor apartment block where – because Openreach can't get a cherry picker to reach the top of the building – the first five floors can have fibre broadband, but the top two cannot. "Unless building landlords actually get on board, they're almost impossible to solve," he said.

## Rural challenges

Much of the hard work in reaching the more remote rural areas has been completed by the "altnets" – one of the 100 or so smaller fibre providers that have sprung up in the UK over the past decade. BDUK has awarded 35 Project Gigabit contracts to ten altnet operators, reaching almost a million properties, according to a recent INCA report.

However, as Ferguson alluded to earlier, some of these smaller providers have found it tough to deliver on contracts. For example, Full Fibre Ltd "mutually agreed to terminate" a Project Gigabit rollout for the Derbyshire Peak District and Herefordshire in May, with BDUK forced to look for a new supplier. Projects in Mid West Shropshire and Cheshire faced similar challenges.

The increase in interest rates in recent years has made it increasingly harder for altnets to finance builds, with many now focusing on attracting more customers to networks they've already built rather than expanding further. For the second year running, access to finance was cited as the biggest concern for altnets in INCA's recent report. Interest rates have climbed by 3-4 percentage points since they borrowed to build at around 7-8%, the INCA report states. The report adds that consolidation among the altnets will help to make their businesses more profitable.

"Consolidation is a natural part of the market," said INCA's CEO, Paddy Paddison. "The network doesn't disappear because the company name changes."

Indeed, there's even a suggestion that the government is trying to proactively encourage the bigger networks to gobble up the smaller altnets. The chief executive of Liberty Global (owner of Virgin Media) recently claimed that business secretary Jonathan Reynolds was "anxious" for his and other larger firms to buy up altnets, in case "fibre customers lose service and fibre investors lose money", according to a report in the *Financial Times*. A government spokesperson denied the minister made such comments.

> "At the start of the project we were looking at small towns, and now we're into the small villages, and we're going to get to the extremes"

"I hate to say it, but it's in his interest to talk down an altnet if he wanted to buy them," said Paddison of the Liberty Global chief executive's comments.

## Reaching the finish line

Even with another two years to hit that 99% figure, will that target be met? Is there enough funding in the pot to light up the hardest places to reach?

"It's hard to say," said Paddison, "and every year you wait, things get a little bit more expensive anyway."

"At the start of the project we were looking at small towns, and now we're into the small villages, and we're going to get to the extremes, where you're going to have to look at other technologies to stay within the pricing. So as long as they [the government] don't try and go, 'Oh, here's the cheapest solution, let's just do that', then hopefully they'll work it through."

Andrew Ferguson said it was always going to be the case that the "final percent" of the population would have to be reached by alternate technologies, whether that's satellite or some other fixed wireless solution. "The question is whether that 1% is going to be bigger now, because the deadline's stretched out."

# Open-source firms stir up Windows 10 backlash

### EndOf10 campaign highlights Windows alternatives

**A group of open-source companies is urging users to consider Linux instead of dumping soon-to-be-defunct Windows 10 PCs.**

**The EndOf10 campaign (endof10.org) has the support of The Document Foundation (makers of LibreOffice), openSUSE and repair firm iFixit, among others. The group is raising awareness of the free alternatives that could keep a Windows 10 PC running beyond the October support deadline and highlighting repair cafés and independent stores where people can get help with installing a Linux OS.**

**KDE, another of the organisations backing the campaign, doesn't mince its words on a page on its own site welcoming "Windows 10 exiles". To persuade Windows 10 users who can't install 11 to avoid buying new hardware, KDE says "you will be forced to spend your hard-earned cash and will be unwillingly polluting the earth and water as your old machine rots in a landfill".**

**It adds: "Even if you agree to this tech extortion now, in a few years' time, they will do it again as they have done many times in the past."**

**LibreOffice is also drumming hard on Windows users' consciences. "Linux and LibreOffice are not just alternatives; they are superior choices that most users have not considered until now because they trusted Microsoft – perhaps too much," a blog announcing its support for EndOf10 states.**

**"This trust has been betrayed by the decision to abandon a functioning operating system such as Windows 10, purely to sell more products and lock users in further, which cannot be justified by any technological assessment."**

**Statcounter's latest figures put Linux's share of the worldwide desktop operating system market at a shade over 4%, which is more than double the market share of Chrome OS. That's grown considerably over the past decade – its market share in May 2014 was only 1.5%. Meanwhile, Windows' desktop market share has fallen from just below 90% in 2014 to just over 70% today.**

**In next month's *PC Pro* we'll be exploring the options open to people still running Windows 10.**

# The Interview

# Garfield AI no legal fat cats

## Philip Young, Garfield AI

**A new AI law firm handles the small claims court paperwork for you**

People don't pay small businesses because they know they can get away with it: small business owners don't have the time to pursue debtors through the courts and lawyers are too expensive. A new AI law firm claims to wipe away those barriers.

Garfield AI is a service that manages the entire small claims court process from beginning to end. From polite chaser letters to a bundle of documents ready to present to the court, the AI pretty much handles everything, working for fees that most lawyers would laugh at.

But could you really trust an AI bot to deliver a court victory for you? The company's CEO and co-founder talked to *PC Pro* to explain why you should.

**PC Pro: Why did you create Garfield AI? What problems were you trying to solve?**

**Philip Young:** I was a lawyer for 25 years in City of London, and I did a lot of big-ticket litigation and commercial stuff. I've always been a giant nerd, I've always loved computers, I've always done programming since I learned from the 8-bits in the 1980s. And then ChatGPT 3.5 was released, and that was when I first really became interested in LLMs.

The more I played with them, the more I thought this thing is really going to be revolutionary for a lot of knowledge-based industries, and particularly for law, where obviously I have a huge background.

The obvious problem to solve was my brother-in-law Andy's problem. He's a plumber and Andy's problem, like all small business people, is from time to time they do some work for somebody who then just doesn't pay them. They can't keep up with their paperwork.

> "It started as a hobby, but became pretty serious pretty quickly"

They certainly don't have time to write lots of chasing letters, and they find lawyers and the law process really daunting, and lawyers are uneconomic to play into that level.

So I thought I'd find myself a technical co-founder, and I went out and interviewed a whole bunch of guys and I found Dan. We just clicked. It started as a hobby, but became pretty serious pretty quickly when we realised that what we were doing was very doable.

**PC Pro: Explain how Garfield works.**

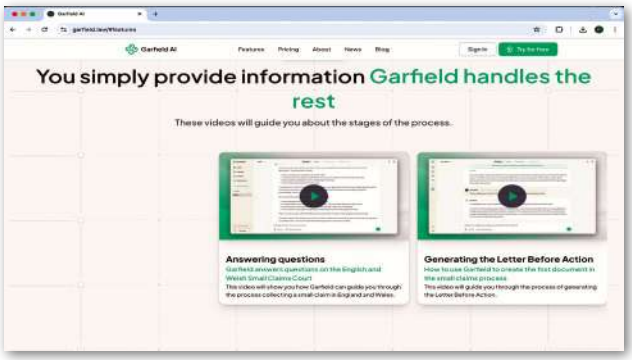
**Philip Young:** Garfield echoes what a good law firm would do for a client with a claim like this. The first step is like with a law firm, you have to give them documents. For Garfield, what that means is that you just drag and drop [invoices and contracts] onto it in a really simple way.

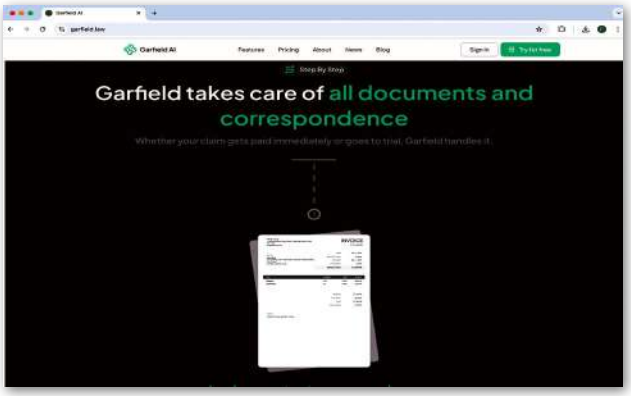
Garfield then has a read of what you've given it. It works out whether or not it's a small debt claim. If it isn't, it tells you. If it is... it tells you what it's understood. And then it gives you options: do you want to send a polite chaser or do you want to send a letter before action? If you tell it you want to do either of those two things, it works out whether it needs any more information from you to comply with the requirements.

You can then review it, and... decide either to approve it, in which case Garfield sends it for you, or you can ask for changes. And that essentially is a process it repeats from each stage of the case.

**PC Pro: What happens if the debtor doesn't pay up?**

**Philip Young:** Then Garfield will say your next course of


You simply provide information Garfield handles the rest
These videos will guide you about the stages of the process.
Answering questions
Generating the Letter Before Action



**RIGHT The Garfield service has been welcomed by the judiciary and approved by the SRA**

action is the small claims court, do you want to do that? And if you say yes, Garfield will then generate the court claim, all the court documents for you, present them to you; you review them, you approve them, or ask for changes. If you approve them, Garfield sends it to the court electronically.

The court issues and serves them, and then the case pathways will diverge depending on what the debtor does. So, the debtor hopefully pays you or offers a settlement, in which case, great – you're going to get paid pretty quickly.

The debtor might ignore you, in which case Garfield helps you apply for the full judgment. Or the debtor in a very small minority of cases – it's only about 2-5% – may file a defence. In which case, Garfield helps you with the defence. Garfield does everything up to the open trial, including a report, trial bundle and skeleton argument, and gives you a speech if you want to represent yourself.

**PC Pro: What do the courts make of this?**

**Philip Young:** I reached out to the senior judiciary last autumn. I obviously know a lot of them because of what I used to do for a day job. I showed them Garfield, I said is this something the industry is going to support or dislike? Because if they're going to dislike it, then I might as well do something else. The reaction was far more positive than I was expecting.

I was expecting a lukewarm reaction, but the judiciary said this is brilliant. They said we can't endorse any product, of course, but we're totally for anything that helps access to justice. We're totally for anything that helps ordinary people's problems get resolved.

This is a big plus for the court service for a number of reasons. They said, first of all, our biggest problem is we have so many people going through the court system that cannot afford representation or don't get representation, and they create a lot of time for judges trying to unscramble whatever case they think they've got. They said something like Garfield will create uniformity in quality of cases. They're just given a nice, neat bundle and can deal with it really quickly.

The other big value is that it helps them on the money. A big chunk of the funding that the court service gets is from the bulk debt claim issuance that goes through the issuing centre at the Northampton County Court. If you're increasing that you're actually increasing the amount of revenue that comes into the court service.

**PC Pro: Is there any human involvement in the process at all?**

**Philip Young:** In the early stages, I'm still checking as it goes out the door, because I'm a cautious lawyer. While we're scaling, I want to make sure that everything that's happening is what should be happening. But over time, I've agreed with the Solicitors Regulation Authority (SRA) that I will move toward the sampling approach. So I will only start to check the areas where there is risk, as opposed to areas where it's more straightforward.

**PC Pro: How do you guard against AI hallucinations?**

**Philip Young:** I've been super-conscious about hallucination since we started building Garfield because it was really obvious, even for ChatGPT 3.5, that this is an inherent thing with a probabilistic LLM. So we built the architecture around making sure that this is not a risk, [by building a] deterministic expert system bolted together with a probabilistic system. I think if you just simply had a probabilistic system, you'd be asking for trouble, because you'd be giving it too much free reign.

The second thing is that, like any good law firm, we also report to the user constantly. It's not a situation where the user presses the button and Garfield goes off like Terminator and does stuff. Garfield tells the user at each stage what it's understood.

Third, technological development. OpenAI, Google, Anthropic, Meta – they're all pouring huge sums of money into reducing hallucinations. I've seen lots of statistics online that have shown that they've really dropped a lot, even over two years. Personally, I think they'll never get to zero, because I think they are an inherent thing in a probabilistic system. But ultimately what matters is if they get to lower than human error.

## THE OFFICIAL SEAL OF APPROVAL

**Entrusting a legal process to AI is a leap of faith, but it's one that comes with official backing. In May, Garfield became the first AI law service to win approval from the SRA.**

**"I knew at an early stage I needed to be regulated and so I reached out to the SRA, and we're regulated as though we are a law firm, even though we're the first law firm in the world to offer service by AI rather than by human," said Young. "We comply with all of the ethical and regulatory standards that any other law firm would comply with."**

**The SRA claims it's performed a series of checks to ensure Garfield doesn't pose a risk to users. "For instance, we have sought reassurance that there are appropriate processes in place to quality-check work, keep client information confidential, and safeguard against conflicts of interests," the SRA said in a statement. It also checked the firm was managing the risk of hallucinations.**

**Paul Philip, the SRA's chief executive, said: "As this is likely to be the first of many AI-driven law firms, we will be monitoring progress of this new model closely."**

# The A-List

The best products on the market, as picked by our editors

PC PRO A-LIST

## PREMIUM LAPTOPS

### Apple MacBook Pro M4

**M4 beast from £1,599**

**from apple.com/uk**

This M4 update to the already brilliant MacBook Pro line is an easy recommendation, so the big question becomes do you choose the 14in version from £1,599 or 16in from £2,499? And then how much do you upgrade, as Apple isn't afraid of high prices. But whatever you choose should last for years, and look great while it's doing it.
REVIEW **Issue 364, p50**

### Apple MacBook Air M4

If you don't need the all-out power of the Pro, this is a brilliant, cheaper alternative despite the unchanged chassis and screen. **13in from £999, 15in from £1,199 from apple.com/uk**
REVIEW **Issue 368, p54**

### Asus Zenbook S 14 OLED

Asus pairs a Core Ultra 9 288V with a 72Wh battery to produce a laptop that lasts almost 20 hours on a charge. What's more, this 1.2kg machine looks (and feels) the business. **From £1,750 from scan.co.uk**
REVIEW **Issue 362, p46**

### Asus ProArt PX13

With AMD's new Ryzen AI 9 HX 370 inside, this 1.4kg compact powerhouse offers incredible amounts of power. Add a fantastic OLED screen and RTX 4070 graphics and it's a winner. **From £2,000 from uk.store.asus.com**
REVIEW **Issue 361, p50**

## BUSINESS LAPTOPS

### Dell Pro 13 Premium

**Sheer quality from £1,452 exc VAT**

**from dell.com**

Dell's business laptop series has a new name, but its commitment to build quality and astonishing levels of configuration remain the same. Here, you benefit from a 1.1kg weight and 24-hour battery life, with Intel's 200V vPro series there for easier remote management. Just make sure you avoid the cheap screen option.
REVIEW **Issue 368, p46**

### Lenovo ThinkPad X1 Carbon Gen 13

The best executive laptop out there, with true all-day battery life even if you buy the 14in OLED version. At 1kg and with the latest components, it's worth the price. **From £1,875 exc VAT from lenovo.com**
REVIEW **Issue 370, p52**

### Lenovo ThinkPad T14s Gen 6 (Snapdragon)

There's no better laptop if you want to try out Snapdragon, thanks to its combination of build quality, speed and battery life. **£1,500 exc VAT from lenovo.com**
REVIEW **Issue 360, p56**

### HP OmniBook Ultra Flip

A top-quality 2-in-1 with a terrific 14in OLED panel, great build quality and superb battery life thanks to Intel's latest generation Core Ultra 7 processors. **From £1,699 from hp.com**
REVIEW **Issue 365, p46**

## CREATIVE & GAMING LAPTOPS

### Lenovo Legion Pro 7i Gen 10

**RTX 50 power from £2,800**

**from lenovo.com**

A surprisingly elegant chassis considering the power within, even if it still weighs 2.7kg. In return you get a 16in OLED panel, Intel Core Ultra 9 275HX CPU and, in our test system's case, and Nvidia RTX 5080 GPU. Lenovo simply doesn't put a foot wrong.
REVIEW **Issue 370, p75**

NEW ENTRY

### Asus ROG Zephyrus G14 (2025)

AMD's Ryzen AI 9 HX 370 CPU combined superbly with the RTX 5080 GPU in this slimline chassis complete with 14in OLED panel. **RTX 5080, £3,200 from asus.com**
REVIEW **Issue 370, p72**

### Asus ProArt P16 (2025)

Packing a RTX 5070, Ryzen AI 9 and brilliant 16in OLED panel into its slim, 1.9kg chassis, this is a fantastic choice for demanding creatives. **£2,800 from asus.com**
REVIEW **Issue 371, p60**

### Asus ROG Strix Scar 18 (2025)

Don't want to make any compromises? Choose this 18in monster, which weighs 3.3kg but extracts every drop from its components. **RTX 5090, £4,700 from asus.com**
REVIEW **Issue 370, p71**

## EVERYDAY LAPTOPS

NEW ENTRY

### Lenovo Yoga Slim 7x

**Copilot+ PC for £899**

**from currys.co.uk**

Lenovo fought off all-comers in our most recent group test due to its all-round quality – we love the slimline, blue, all-metal design and 14.5in OLED panel – and the fact that its battery keeps this 1.3kg laptop going for over 20 hours. It's a great advert for Qualcomm's Snapdragon X Elite chips.
REVIEW **Issue 371, p88**

NEW ENTRY

### Asus Vivobook S15

This affordable laptop still includes an all-metal shell and 15.6in OLED panel, saving money by using a solid 8-core Snapdragon X Plus chip. **£699 from currys.co.uk**
REVIEW **Issue 371, p83**

NEW ENTRY

### HP OmniBook Ultra 14

If you have £999 to spend, consider the 16GB/512GB version of this cracking machine, with its aluminium chassis, 14in IPS panel and speedy Ryzen AI 365 CPU. **From £999 from hp.com**
REVIEW **Issue 371, p87**

NEW ENTRY

### Microsoft Surface Laptop, 13-inch

Another laptop powered by a Snapdragon chip, but it's low power so this stylish laptop is best for less demanding tasks. **From £899 from microsoft.com**
REVIEW **Issue 371, p54**

## CHROMEBOOKS

NEW ENTRY

### Samsung Galaxy Chromebook Plus (2024)

**Core 5 power for £749**

**from samsung.com**

The first truly desirable Chromebook since the Pixelbook, this is a top-quality laptop from the all-metal chassis to the 15.6in Full HD OLED screen. And thanks to Intel's Core 5 120U processor, it's fast enough to last for years.

REVIEW **Issue 364, p65**

### Acer Chromebook Plus 516

If you can't afford the 15.6in Samsung Galaxy Chromebook Plus then Acer's Chromebook Plus 516 makes a solid but less beautiful alternative – as reflected in its price. The 15.6in screen provides plenty of space on which to work, and it proved a fast performer in our tests.

**From £399 from acer.com**

REVIEW **Issue 371, p90**

### Acer Chromebook Spin 714

If you're looking for a convertible, this is the best choice around. Others may beat the 12th gen Intel Core i5 we tested for performance, but for features, design and bang for buck you won't find any laptop that can match this 2-in-1 for the money.**£799 from currys.co.uk**

REVIEW **Issue 356, p83**

## MINI PCs

### Apple Mac mini M4

**Little monster from £599**

**from apple.com/uk**

This is a big and timely update for the Mac mini, with a much smaller (and squarer) design that's easy to tuck behind a screen. But what lifts it above the pack is the astonishing power of the M4 and M4 Pro chips, with barely any cooling required. As ever with Apple the upgrade costs are high, but at least its starting price is reasonable.

REVIEW **Issue 364, p44**

### Geekom A6 Mini PC

The Geekom A6 Mini PC steals the A8's place on our A List thanks to its sheer value for money. The A6 costs £220 less but doesn't compromise on quality or connectivity, and while the Ryzen 7 6800H is a step down from the Ryzen 9 8945HS in the A8, it remains a superb performer.

**£499 from geekom.co.uk**

REVIEW **Issue 367, p56**

### Minisforum Venus UM790 Pro

Ignore its basic looks, for this compact system packs in a fast AMD Ryzen 9 7940HS processor, 32GB of DDR5-5600 RAM and 1TB SSD along with a generous selection of ports, including two USB-C 4 connectors. And the price is super-aggressive.

**£549 from store.minisforum.uk**

REVIEW **Issue 363, p91**

## ENTHUSIAST PCs

### Scan 3XS Edge iCue

**Silent but deadly fast for £2,800**

**from scan.co.uk**

With the RTX 5080 comes a refresh of best enthusiast PCs. The Scan is a shade slower than its Ryzen 9 9800X3D rival from Wired2Fire, but even at full pelt it remains astonishingly quiet.

REVIEW **Issue 367, p50**

### CyberPower PC Ultra 3D5090

If you're after the fastest gaming PC you can buy for £4,000, let's make things easy for you: buy this. It's packed with speedy components, from AMD's Ryzen 9 9950X3D to RTX 5090 graphics to a 2TB Gen 5 SSD.

**£4,000 from tinyurl.com/370cyber**

REVIEW **Issue 370, p58**

### PCSpecialist Hydra R60S

This compact PC makes little noise but still packs a gaming and creative punch thanks to RTX 4060 graphics and AMD's older but speedy Ryzen 5 7500F. You can upgrade to an RTX 5070 when budget allows. **£999 from pcspecialist.co.uk/reviews**

REVIEW **Issue 368, p60**

## ALL-IN-ONE PCs

### HP Envy 34 All-in-One

**£2,099 widescreen wonder**

**from hp.com**

Built around a high-quality 34in widescreen – which is perfect for viewing two windows side by side thanks to its 21:9 aspect ratio – this also comes with Nvidia RTX 3060 graphics. We're big fans of the magnetic 16-megapixel camera, too.

REVIEW **Issue 335, p46**

### Dell Inspiron 24 All-in-One

Despite being built to hit a price point, the Inspiron 24 All-in-One manages to look classy, include a good-quality, 1,920 x 1,080 24in panel and have enough power to breeze through a typical day's tasks. It even packs mod cons such as a 720p webcam. Superb value for money.

**From £599 from dell.co.uk**

REVIEW **Issue 350, p47**

### Apple iMac M4

Anyone hoping for a 27in iMac will be disappointed, but everyone else should be delighted by this M4-powered all-in-one with its 24in 4,480 x 2,520 IPS panel. It's fast inside and out, too, with Thunderbolt 4 and Wi-Fi 6E both part of the package. **From £1,299 from apple.com/uk**

REVIEW **Issue 364, p48**

## CREATIVE WORKSTATIONS

### Armari Magnetar M64T7-AW1650G4

**Threadripping power for £8,329 exc VAT**

**from armari.com**

AMD's Ryzen Threadripper 7980X is the star of this particular show, dominating our benchmarks with the help of 128GB of RAM, two 2TB Crucial PCI-E 5 drives in RAID0 configuration and AMD's Radeon Pro W7800 professional GPU. And it's all wrapped up in a custom Armari case with liquid cooling.

REVIEW **Issue 361, p92**

### Scan 3XS Evolve Studio Pro

Thanks to its combination of a Ryzen 9 9950X3D and GeForce RTX 5090, this will race through games – but it's also a fantastic choice for 3D animation and modelling. With top-quality components throughout and a gorgeous case, it will perform for years. **£4,167 exc VAT from tinyurl.com/369scan**

REVIEW **Issue 369, p48**

### Apple Mac Studio

Now updated with your choice of M3 Ultra or M4 Max chips, this is the natural choice for professionals who rely on Apple hardware (or software). As with all Apple products, prices rocket once you add memory and storage, but this is a long-term investment. **From £1,749 exc VAT from apple.com**

REVIEW **Issue 369, p52**

## TABLETS

NEW ENTRY

### Apple iPad Air M3

**Languid power from £599**

**from apple.com/uk**

It's hard to be too excited by this update as it's exactly the same design but with an M3 chip inside. But when the original was so damn good, whether in 11in or 13in variants, and Apple Intelligence is thrown in, it remains the best choice for the vast majority of tablet buyers.

REVIEW **Issue 368, p56**

### Apple iPad Pro M4

The best tablet in the world becomes even better thanks to Apple's stunning M4 chip, a gorgeous OLED screen and the must-have accessory: the all-new Pencil Pro. But it comes with an obvious downside of cost, with the cheapest 13in incarnation costing £1,299. **From £999 (11in, 256GB) from apple.com**

REVIEW **Issue 358, p48**

### OnePlus Pad 3

Not only the best Android tablet you can buy but a genuine rival to the iPads thanks to its support for Apple products via integrated file sharing and a Mac Remote Control feature. It's also fast, packs a superb 13.2in screen and comes with a fine array of accessories. **From £529 from oneplus.com**

REVIEW **Issue 371, p62**

## EVERYDAY PHONES

NEW ENTRY

### Google Pixel 9a

**Why pay more? From £499**

**from store.google.com**

If you can live without an optical zoom then it's hard to think of a reason to pay more for a phone. The AI features are genuinely useful, it's fast, the battery lasts forever, the camera is superb and the 6.3in OLED panel is a joy to gaze at.

REVIEW **Issue 369, p74**

### Nothing Phone 3a

Looking to get the best possible phone for around £300? This is it. Quite aside from Nothing's unique design, it features a gorgeous display and high-quality cameras – including an optical zoom that few phones in this price bracket can match.

**£329 from nothing.tech**

REVIEW **Issue 368, p77**

### Honor 400

This is a luxury phone without the luxury price. Taking many cues from the iPhone's design, including its software, the Honor 400 packs a 6.6in AMOLED panel, high-quality 200MP main camera and a mid-range Snapdragon processor. It's great value.

**256GB, £400 from honor.com**

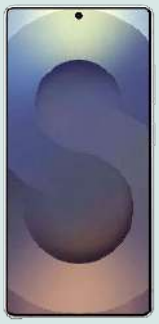
REVIEW **Issue 371, p72**

## PREMIUM PHONES

### Samsung Galaxy S25 Ultra

**AI in your hand from £1,249**

**from samsung.com/uk**



So good it tempted our reviewer – an iPhone devotee – to move to the other side. That's thanks to the faultless hardware, brilliant photography performance and Samsung's slick AI, not to mention the integrated S Pen stylus. It's not cheap, but you're buying for the long term with seven years of OS updates.

REVIEW **Issue 367, p70**

### Honor Magic V3

With the Magic V3, not only does Honor make foldable phones as slim as flagship phones but also as affordable – so long as the £300 discount voucher still applies, as shown in the price here. What's more, the cameras and both OLED panels are superb. **£1,400 after discount from honor.com**

REVIEW **Issue 362, p62**

### Apple iPhone 16 Pro

Even without Apple Intelligence, the introduction of a 5x optical zoom, classy 6.3in OLED panel and Apple's ludicrously fast A18 Pro chipset make this the best update to an iPhone Pro for years. And if you need one more reason to buy, how about its much improved battery life? **128GB, £999 from apple.com/uk**

REVIEW **Issue 363, p70**

## EVERYDAY MONITORS

### Iiyama ProLite XUB3293UHSN-B5

**32in 4K bargain, £429**

**from currys.co.uk**

The fact that this 31.5in IPS monitor could compete so well against Eizo's alternative (*see below*) says it all. Great colour coverage in sRGB and DCI-P3, USB-C and RJ45 inputs, plus solid build quality add up to a bargain.

REVIEW **Issue 357, p88**

### AOC Q27B3CF2

AOC's relentless focus on value delivers a 27in 1440p screen with a high-quality IPS panel that costs £200 including VAT – and also packs in a USB-C port. Those are almost the only features you get, and the OSD is awful, but at this price we're not complaining.

**£200 from amazon.co.uk**

REVIEW **Issue 360, p77**

### Acer Verso B277 Ebmiprzxv

This is a basic but high-quality monitor, delivering colourful images across its 27in Full HD diagonal. You don't get USB-C docking, but it includes VGA, HDMI and DisplayPort inputs, plus a two-port USB hub.

**£149 from tinyurl.com/357acer277**

REVIEW **Issue 357, p84**

## PROFESSIONAL MONITORS

### Eizo FlexScan EV3240X

**Stunning 4K quality, £1,206**

**exc VAT from photospecialist.co.uk**

With images that whack you between the eyes as soon as you lift it, fully assembled, from its box, this 32in 4K monitor is our top choice pick for anyone willing to make such a hefty long-term investment.

REVIEW **Issue 357, p91**

### Eizo ColorEdge CG2700X

A brilliant choice for professional designers, whether working solo or in teams, thanks to its dedication to providing accurate colours across potentially years of life. It's also bang up to date for connectivity, with USB-C and RJ45 making it easy to manage, too. **£2,149 exc VAT from wexphotovideo.com**

REVIEW **Issue 357, p90**

### BenQ PD2706U

If you can't stretch to Eizo budget levels then this 4K 27in screen is definitely worth investigating. It has several features aimed at professionals, including a Hotkey Puck to switch between profiles, plus great coverage of the sRGB and DCI-P3 gamuts. **£333 exc VAT from scan.co.uk**

REVIEW **Issue 357, p86**

## WEBCAMS

### Logitech MX Brio 705 for Business

**Consistent brilliance for £219**

**from logitech.com**

Consistent image quality in all lighting conditions coupled with top build quality and nifty features – such as a presenting mode for items on your desk – make this a fantastic all-round choice.
REVIEW **Issue 356, p68**

### Logitech Brio 105 for Business

While you can buy 1080p webcams for a third of the Brio 105's price, they won't hold a candle to the Logitech webcam's quality – especially in low-light conditions, such as one candle. It's also easy to manage, for businesses and individuals.
**£45 from logitech.com**
REVIEW **Issue 360, p77**

### Obsbot Tiny 2

This portable 4K webcam delivers for quality, design and sharpness, and it comes with a shedload of advanced features, including dynamic zoom and subject tracking. The only real downside is that it has a price that reflects its premium ambitions.
**£329 from amazon.co.uk**
REVIEW **Issue 352, p75**

## HOME OFFICE PRINTERS

### HP OfficeJet Pro 9135e

**Do-it-all inkjet for £193**

**from printerbase.co.uk**

This versatile inkjet all-in-one – which includes a 35-page ADF – pumps out high-quality prints at laser-rivalling speeds. Likewise scans and copies. Print costs are reasonable, too.
REVIEW **Issue 365, p85**

### Epson EcoTank ET-2865

As usual with ink tank printers, you don't get many frills with the Epson EcoTank ET-2865 (so no ADF or screen). What you do get is incredibly low running costs of 0.5p for colour and 0.2p for mono, plus high-quality prints and scans.
**£233 from uk.insight.com**
REVIEW **Issue 365, p84**

### Canon i-Sensys LBP243dw

Everything you could want from a mono laser printer – it doesn't come with a scanner – the LBP243dw produces excellent results at speed. You also get Wi-Fi and wired networking. **£186 from printerbase.co.uk**
REVIEW **Issue 365, p88**

## WORKGROUP PRINTERS

### Canon Maxify GX6550

**Ink tank all-in-one for £392 exc VAT**

**from canon.co.uk**

Designed to fit in tight spaces, this all-in-one includes a highly effective ADF and backs it up with high-quality prints at 24ipm in our tests. Running costs are superb, too.
REVIEW **Issue 350, p58**

### Brother HL-L9430CDN

This laser printer (not an all-in-one, so there's no scanning or copying functionality) is a great choice for a busy office, producing sharp black text and making a good job of colour graphics as well. All while doing so quickly with a competitive price per page. **£415 exc VAT from printerland.co.uk**
REVIEW **Issue 353, p84**

### Xerox B315DN

A fine alternative to the Brother and Canon, this mono laser multifunction printer produces superb results at great speed – 27.5 pages per minute in our 50-page test, which includes the spool time. It's similarly quick for scans, with a dual-CIS ADF to speed up double-sided copies. **£238 exc VAT from printerbase.co.uk**
REVIEW **Issue 341, p87**

## WIRELESS ROUTERS

NEW ENTRY

### Netgear Nighthawk RAXE300

**Fast Wi-Fi 6E router, £350**

**from amazon.co.uk**

The RAXE500 is faster than the RAXE300, but in practice we doubt you would notice – this tri-band router still delivered speeds between 50MB/sec and 150MB/sec in our tests. And it's packed with features, too. At £150 cheaper than its bigger brother, we think it hits the Wi-Fi 6E sweet spot.
REVIEW **Issue 341, p68**

### TP-Link Archer BE550

At almost half the price of the Netgear Nighthawk RAXE300, this is a brilliant mid-range choice thanks to a 6GHz radio and five 2.5GbE ports – you'll enjoy superb wired and wireless performance, and it even comes with a wide set of features. **£180 from amazon.co.uk**
REVIEW **Issue 371, p70**

NEW ENTRY

### Asus RT-BE58U

A great deal for those on a tight budget, this dual-band Wi-Fi 7 router (there's no 6GHz radio) performed well in our 5GHz tests at a price that can't be beaten. You can even enable MLO across the 2.4GHz and 5GHz bands.
**£99 from amazon.co.uk**
REVIEW **Issue 371, p70**

## MESH WI-FI

### TP-Link Deco XE200

**Clever Wi-Fi 6E for £400**

**from amazon.co.uk**

There are cheaper Wi-Fi 6E meshes, but the XE200 wins for its superb download speeds, excellent coverage and the fact that older clients reap benefits of 6E, not just new ones. And a two-pack (code BOBKTDPWC8) should be enough for most premises.
REVIEW **Issue 349, p65**

### Netgear Orbi 770

If you're eager to upgrade to Wi-Fi 7 then the Orbi 770 is the best mesh option yet. Its speed and range are both excellent, with a twin-pack covering 420m² (says Netgear), and the wired connectivity superb: four 2.5GbE connectors on the router unit, two 2.5GbE ports on the satellites. But it ain't cheap. **2-pack, £600 from amazon.co.uk**
REVIEW **Issue 364, p70**

### Linksys Velop Pro 6E

Ironically, this Wi-Fi 6E router will get the most out of your non-Wi-Fi 6 devices thanks to its use of the 6GHz network for station-to-station traffic. And you only need two units for rock solid performance across a three-bedroom house. **2-pack, £380 from amazon.co.uk**
REVIEW **Issue 350, p54**

## BUSINESS WI-FI

### Ruijie Reyee RG-RAP73Pro

**Wi-Fi 7 AP, £201 exc VAT**

**from broadbandbuyer.com**

The RG-RAP73Pro delivers a wealth of features and top Wi-Fi 7 performance at a tempting price. Broadbandbuyer's provisioning service makes light work of deployment, and the free Ruijie Cloud service offers top-notch remote management.
REVIEW **Issue 369, p103**

### TP-Link DR3650v

"Business Wi-Fi" doesn't do justice to this all-in-one communications, security and networking solution, which combines a dual-band AX3000 access point with WAN redundancy, failover services and a treasure trove of features. **£208 exc VAT from broadbandbuyer.com**
REVIEW **Issue 368, p103**

### EnGenius ECW526

The ECW526 is a top choice for SMBs looking to make the move to Wi-Fi 7 as it combines a great feature set at a tempting price. Cloud management services are extensive, and its potent Qualcomm CPU and 10GbE port deliver superb wireless performance. **£225 exc VAT from solwise.co.uk**
REVIEW **Issue 366, p102**

## NAS SERVERS

### Synology DiskStation DS1823xs+

**10GbE NAS, £1,413 exc VAT**

**from broadbandbuyer.com**

This stalwart retains its top spot on the A-List thanks to its powerful performance (courtesy of a Ryzen chip), huge capacity via eight LFF/SFF hot-swap SATA bays and an unmatched set of business-friendly apps. And it's all built on Synology's DSM 7.2, which is focused on data security.
REVIEW **Issue 368, p99**

### Asustor Nimbustor 4 Gen2 AS5404T

Built for SMBs and enthusiasts who demand the best performance, the AS5404T is a four-bay NAS that offers much more than most, with some nice surprises under its standard-looking exterior. **£441 (£529 inc VAT) from amazon.co.uk**
REVIEW **Issue 369, p88**

### Qnap TS-264

The Qnap TS-264 is aimed at those who want a bit more from a traditional two-bay NAS. It's effectively the two-bay version of the excellent four-bay TS-464, and like its sibling provides strong speeds over its pair of 2.5GbE ports – and includes two M.2 NVMe slots. **£391 (£469 inc VAT) from ukstore.qnap.com**
REVIEW **Issue 369, p86**

## VIDEOCONFERENCING

### Biamp Parlé VBC 2800

**Go big for £2,918 exc VAT (MSRP)**

**from midwich.com**

We thought the VBC 2500 was a great VC room bar, and the new VBC 2800 delivers Biamp's undeniable expertise to larger meeting rooms. Video and audio quality are outstanding, speaker framing is super fast and the smart combination of dual camera lenses makes sure everyone is in the big picture.
REVIEW **Issue 364, p98**

### Owl Labs Medium Room Solution

The Owl 4+ and Owl Bar partnership offers smart tracking and dynamic split-screen views to ensure everyone is in the picture, while the Whiteboard Owl adds extra professionalism to presentations and training sessions. **Owl 4+, Owl Bar, TV mount, £2,999 exc VAT from owllabs.co.uk**
REVIEW **Issue 364, p100**

### Ricoh Meeting 360

Ricoh's Meeting 360 is up against stiff competition in the panoramic meeting hub market but stands out for its excellent build quality and generous three-year warranty. It's easy to use and delivers good video and audio quality, while the smart app allows you to create a view for every occasion. **£744 exc VAT from amazon.co.uk**
REVIEW **Issue 364, p101**

## SCANNERS

### Brother ADS-4900W

**60ppm for £529 exc VAT**

**from tradescanners.com**

An incredible range of features at a competitive price. Scan speeds are even faster than the quoted 60ppm, output quality is excellent and top-notch software and apps deliver a wealth of options.
REVIEW **Issue 370, p98**

### Ricoh fi-8040

Ricoh's fi-8040 offers SMBs a remarkable range of features for a great price. Output quality is beyond reproach, it delivers on its 40ppm promises and the multiple operational modes make it highly flexible. **£249 exc VAT from thescannershop.com**
REVIEW **Issue 370, p101**

### Canon imageFormula DR-S350NW

You don't need to install this affordable networked desktop scanner, which almost hit 55ppm scan speeds in our test. Canon backs it up with a fine software package. **£433 exc VAT from printerland.co.uk**
REVIEW **Issue 370, p99**

## SECURITY APPLIANCES

### Firewalla Gold Pro

**Top-value protection for $899 (£676)**

**from firewalla.com**

A great choice for SMBs that delivers a wide range of security features at a tempting price. Our 10GbE tests show it can easily cope with high demand, and don't worry about subscriptions as the price includes all security services and lifetime updates.
REVIEW **Issue 364, p103**

### DrayTek Vigor 2927Lax-5G

This affordable security router is a particularly good choice for smaller businesses. It offers always-on internet access thanks to an unbeatable set of WAN redundancy features whilst building in still-speedy Wi-Fi 6 services. **£667 exc VAT from broadbandbuyer.com**
REVIEW **Issue 360, p98**

### WatchGuard Firebox M390

The Firebox M390 combines strong performance with an incredible range of security measures at a competitive price. It's easy to deploy and a cloud portal delivers remote management and monitoring services. **Appliance with 1yr TSS subscription £4,273 exc VAT from broadbandbuyer.com**
REVIEW **Issue 360, p100**

## SECURITY SOFTWARE

### Avira Prime
Avira wins for all-round AV performance, plus a solid VPN, for a fair price. Watch out for a second-year hike to £91, though. **First year: 5 devices, £52 from avira.com**
REVIEW **Issue 366, p84**

### Bitdefender Total Security
A long-term award winner in our security suite Labs, Bitdefender continues to charm for its consistent AV performance, solid feature set and extremely competitive price. **5 devices, 1yr, £20 from store.pcpro.co.uk**
REVIEW **Issue 366, p85**

### Avira Free Antivirus
There's absolutely no need to pay for a full security suite if you only want antivirus protection, and Avira is our top choice simply due to its excellent and consistent performance in tests. **Free from avira.com**
REVIEW **Issue 366, p89**

## VPNs

### ExpressVPN
Blistering speeds, outstanding region-shifting performance and a good track record on security mean this VPN is worth the expense. **2yr 4mth $140 (£113) from expressvpn.com**
REVIEW **Issue 370, p84**

NEW ENTRY

### Mullvad
A consistent performer with consistent pricing – there's no need to sign up for the long term as it costs only €5 per month as a flat rate – but not the best choice for region shifting. **€5 (£4.34) per month from mullvad.net**
REVIEW **Issue 370, p85**

NEW ENTRY

### Proton VPN Free
While Proton's VPN Plus is also a great choice, if you're looking for a freebie then choose this VPN for its fast connections (or alternatively Windscribe if you need to choose territories). **Free from protonvpn.com**
REVIEW **Issue 370, p89**

## LINUX DISTROS

### Ubuntu
A fine choice for Windows switchers thanks to its familiar design, with regular six-monthly updates and a Long Term Support version. **Free from ubuntu.com**
REVIEW **Issue 367, p92**

### Fedora Workstation
One of the longest-established distros, and with a strong link to Red Hat Enterprise Linux, Fedora Workstation will particularly appeal to business migrators. **Free from fedoraproject.org**
REVIEW **Issue 367, p85**

### Linux Mint
There's a good reason this is a popular choice for Windows 10 refugees, including a familiar "Start menu", and it's easy to give it a trial before committing. But consider Zorin OS, too. **Free from linuxmint.com**
REVIEW **Issue 367, p86**

## CLOUD BACKUP

NEW ENTRY

### IDrive Business
An incredibly affordable hybrid backup solution. It's easy to deploy, supports Google Workspace, Microsoft 365, Dropbox and Box, and is ideal for protecting remote and on-premises systems. **5TB, £791 exc VAT per year from idrive.com**
REVIEW **Issue 371, p100**

NEW ENTRY

### Barracuda Backup Vx
This affordable virtualised on-premises backup solution is easy to deploy on VMware or Hyper-V hosts and integrates local and cloud backup. **From £804 exc VAT per year from barracuda.com**
REVIEW **Issue 371, p99**

## NETWORK MONITORING

### Progress WhatsUp Gold 2024
A great SMB choice as it presents a clear picture of your network and is available in a wide range of licensing plans. It's a cinch to deploy, doesn't require a lot of host resources and the new features make it even easier to customise. **Enterprise, 50 devices, £1,177 exc VAT per year from whatsupgold.com**
REVIEW **Issue 366, p100**

### Park Place Technologies Entuity 22
An impressive toolbox of monitoring services all easily managed from a web console that offers a wide range of informative dashboards. **From $150 per node/year from parkplacetechnologies.com**
REVIEW **Issue 366, p99**

## VOIP SERVICES

### 3CX Phone System 20 Update 5
Deployment options are extensive, call-handling features are excellent and, although you'll need to source a SIP trunk, it's incredibly affordable. **Enterprise, 8SC, £385 exc VAT per year from 3cx.com**
REVIEW **Issue 369, p98**

### TelephoneSystems.Cloud
Ideal for businesses that don't want any unpleasant billing surprises, with an impressive range of call-handling features. **From £11 exc VAT per user per month from telephonesystems.cloud**
REVIEW **Issue 369, p100**

## ENDPOINT PROTECTION

### WithSecure Elements Endpoint Security
A comprehensive set of protection measures for a great price, easily managed from a cloud portal. It supports a wide range of devices and the Luminen tool delivers AI-powered reporting services that present detailed summaries of events with a click. **100-499 devices, £37 exc VAT each per year from withsecure.com**
REVIEW **Issue 363, p101**

### Sophos Intercept X Advanced
An unbeatable range of tough security measures. Deployment is a breeze, and a multitude of security policies make it highly flexible. **100-199 users, £48 exc VAT each per year from enterpriseav.co.uk**
REVIEW **Issue 363, p98**

## REMOTE SUPPORT

### NetSupport Manager 14.1
Sets the standard for on-premises hosted support for local and remote workers. It delivers a remarkable range of features and its one-time cost per seat will appeal to businesses concerned about subscription fees. **1-500 systems, perpetual licence, £10 each exc VAT from netsupportmanager.com**
REVIEW **Issue 361, p100**

### ISL Online Standard
Perfect for SMBs wanting cloud-based support. Features and access security are excellent, as are its flexible licensing plans. **Standard Cloud/One user, £287 exc VAT per year from islonline.com**
REVIEW **Issue 361, p99**

## CLOUD FILE-SHARING

### Progress ShareFile Premium
Progress ShareFile Premium will appeal to SMBs seeking affordable and easily managed cloud collaboration services. It offers plenty of app integrations plus support for large file sizes, and the AI-powered features deliver smart security measures. **£19.90 exc VAT per user per month billed yearly from sharefile.com**
REVIEW **Issue 367, p98**

### Dropbox Business Plus
Collaboration tools, app integrations and a huge maximum file size limit – plus malware scanning and data classification – make this a great choice. **£18 exc VAT per user/month billed yearly from dropbox.com**
REVIEW **Issue 367, p96**

# Colour me olo, there's a new kid in town

**Laser-wielding scientists have discovered a new colour, but unlike sci-fi equivalents it's unlikely to turn the world into ash**

**Dick Pountain is editorial fellow of *PC Pro*. He calls this one-off mugshot "Self-Portrait As Psychedelic Wannabee Despot (Retired)". dickpountain.co.uk**

I've expressed my feelings about science fiction many times before in this column. Probably too many. A big fan in my 1960s teens, a bout of illness in the 1970s let me binge all the greats – Vonnegut, Ballard, LeGuin, Dick, Pohl, Bester – overdosing so badly that I never wanted to read sci-fi again. Looking back now as emotionally retarded pseudo-intellectual sci-fi fans appear to be taking over the world, I think my immune system was telling me something. However, this allergic reaction doesn't apply to the closely related genre of fantasy (or gothic, or cosmic) horror. I still can cringe a little to M P Shiel's *The Purple Cloud*, William Hope Hodgson's *The House on the Borderland* or the entire oeuvre of H P Lovecraft.

One of Lovecraft's stories, "The Colour out of Space", struck me particularly hard. A meteorite lands in a tiny community in the New England woods, containing globules of a weird colour that isn't in the solar spectrum: it has unpleasant effects that consume all living animals, plants and humans and turn them into grey ash. Several unsuccessful attempts have been made to film this story; hard work given that it's not in the Technicolor spectrum either. Perhaps the nearest anyone has come is Alex Garland's 2018 *Annihilation*, which clearly shows Lovecraftian influence and employs a digitally produced shimmer in place of a new colour. I suppose Lovecraft's story is a sort of parable about environmental destruction, but that's not what explains its hold on me – I've always been fascinated by colour, studying its chemistry, reading up on all the various systems, appreciating great paintings and creating my own digital art as a hobby.

> "I've always been fascinated by colour, studying its chemistry, reading up on all the various systems"

All of which explains my enormous excitement on reading in the Science Adviser newsletter about new research at the University of California Berkeley, which "creates" a new colour that lies outside the gamut humans can perceive, but can be seen by shining a laser onto one's retina (don't try this at home, kids).

First some background is required. You already know that our eyes, and hence also digital display devices, perceive or present colours as mixtures of the three components red (R), green (G) and blue (B). That's because the retinas of our eyes contain three types of colour-sensitive cell called "cones", which are sensitive to different wavelengths: long (L), medium (M) and short (S). Objects illuminated by natural sunlight stimulate L, M and S cones to different extents, which gives us the experience of different colours. Red light primarily stimulates L cones and blue light S cones, but since M cones respond to the middle of the range, overlapping with both L and S, there's no component of sunlight that stimulates M alone.

The authors of the Berkeley paper (read it at **tinyurl.com/371color**) set out to investigate a new system for describing colour perception, by using a laser to illuminate retinal cells one at a time:

"We introduce a principle, Oz, for displaying color imagery: directly controlling the human eye's photoreceptor activity via cell-by-cell light delivery. Theoretically, novel colors are possible through bypassing the constraints set by the cone spectral sensitivities and activating M cone cells exclusively. In practice, we confirm a partial expansion of colorspace toward that theoretical ideal. Attempting to activate M cones exclusively is shown to elicit a color beyond the natural human gamut."

> "Thankfully olo hasn't shown any inclination to suck the life force out of living beings and reduce them to ash"

Calling their new system "Oz" was a trigger for me, having cut my journalistic teeth on that notorious hippie journal where my articles were printed in every colour of the rainbow on a background of every *other* colour of the rainbow. But I digress. Their new colour, from stimulating M cells alone with a laser, they named "olo". It can't be reproduced in paint, ink or screen, so you'll only ever see it sitting in a dentists' chair with a laser strapped to your head.

"Subjects report that olo in our prototype system appears blue-green of unprecedented saturation, when viewed relative to a neutral gray background. Subjects find that they must desaturate olo by adding white light before they can achieve a color match with the closest monochromatic light."

Thankfully olo hasn't shown any inclination to suck the life force out of living beings and reduce them to grey ash. The best approximation is a light turquoise, a colour you might glimpse fleetingly when watching a wave break on a rocky headland in bright sunshine. If that sounds familiar it's because astronomers for a while believed the whole universe, by mixing all the light together, would be a light turquoise – but that turned out to be a bug in their software. It's now considered to be a "cosmic latte", a light beige that you can view for yourself in the standard sRGB gamut as #FFF8E7.

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# Tech is changing work. It's time for schools to follow

**The way many people work has changed forever, but until these moves are followed by the rest of society we'll be left with awkward gaps to fill**

**Nicole Kobie is *PC Pro*'s Futures editor. She thinks the future of work should include less of it.**
@njkobie

Unless you're a tech bro or CEO of a finance company, you might have noticed that the world of work has changed. The days of trudging to the office five days a week for eight-hour chunks is over.

Now, that trudge hasn't applied to me for a good long time. I work freelance, which means a home office and working whenever I like – or more accurately, whenever an editor hires me. I shifted to this style of working more than a decade ago, well before it was cool, but I'm heartened to see so many other people appreciate this style of working.

Surveys suggest that most employees are happy in this new world. A survey from recruiter Robert Half found three-quarters of workers state flexibility in where and when they work influences whether they want to stick with an employer. Another poll, this time from Cisco, suggests that 70% of workers would take a pay cut for more flexibility still. Why? Perhaps because it gives employees an average 55 minutes back of time otherwise lost to commuting. Meanwhile companies benefit as it reduces burnout, slashes sick days and absenteeism, and cuts office costs, all while boosting productivity. This is hard data, too, from the American Government Accountability Office.

> "What is the point of productivity tools if they don't give us back our time or lead to us being paid more?"

I'd like all of this to go much further. What, after all, is the point of productivity tools – be it computers, the internet or AI – if they don't give us back our time or lead to us being paid more or both? Based on decades of depressing salary growth data, it's clear companies are unwilling to cough up the green stuff for anyone beyond the C-suite, so the only benefit available to us is time. The technology behind internet communications, productivity software and now AI has given us this: the ability to do our laundry during office hours.

There are downsides to all this flexible home working. Top of the list is that many jobs actually aren't in offices and can't simply be shifted to a laptop at home. And for those that can, I pity new graduates living in flat-shares trying to eke out a happy life and fulfilling career working unsupported from a laptop in their bedroom with no networking or learning opportunities.

There are ways that companies can address such downsides: invite new staff in for an extra day a week, pay for co-working spaces, organise industry-specific meetups and training. But whatever you do, bosses, don't chuck away all the benefits of flexible working; doing so would be to throw the baby out with the bathwater.

Speaking of babies, mine is now a toddler, and we will soon have to put her in preschool/nursery, ahead of reception. What does this have to do with four-day weeks and working from home? Well, I work either three or four days a week. My husband works a four-day week. But she's expected to go to work – okay, school – for the full five days.

I know some parents welcome this. They perhaps have other children who aren't in school yet, and school for older children allows uninterrupted one-on-one time with their younger siblings. Or they have other responsibilities, such as caring for other family members or the sheer hassle of managing a modern household. Or, you know, taking time for themselves. All of that is totally understandable.

But I want my time with my daughter. I want to be able to make use of the city we pay so much to live in. So I would very much like to find a school for her that allows for the same flexibility that we have in our working lives. Short of going private – not an option on a journalist's wages, if you'll excuse my muffled laughter – that's no easy ask.

I get it: managing a classroom of children is hard enough for teachers without adding flexible schedule demands from parents like me. But a handful of state schools have started offering four-day weeks, with Friday a "flex day" where some children still come into class and others don't. I love this model. Make Fridays fun for the kids that are there, and give parents like me that extra day to take her to different classes, travel, or just spend time together.

> "Alongside the usual queries about the quality of hot lunches, we'll be asking about flexible schooling – oh, and about their AI policies"

So what this all means is we've started emailing local schools to arrange tours and asking about waiting lists, but also begun pulling together a list of questions we'll ask of those we visit. I already pity the poor nursery manager or school administrator that is faced with our questions. Alongside the usual queries about the quality of hot lunches and teacher-student ratios, we'll be asking about flexible schooling – oh, and about their AI policies.

I genuinely feel bad for the person giving us a tour, but if the world of work is changing this much, a lot else – schools and plenty more – will have to evolve, too.

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# Tim's Apple has been over-cooked

**With so much money in the bank, it's time for Apple to find another visionary for its next CEO**

**Barry Collins started at *PC Pro* in the same year as Cook started at Apple, though his personal fortune is a tad smaller. Send cheques to barry@mediabc.co.uk. @bazzacollins**

It's hard to think of a more poisoned chalice than following Steve Jobs. You need only look at how Steve Ballmer withered in the hot seat at Microsoft to understand how following an iconic leader is brutally tough, even if you've been their right-hand man for decades. That Tim Cook has done so for nigh on 15 years is nothing short of remarkable. But it's time to move on.

Cook proved to be the right man at a terrible time. A steady pair of hands that knew the business inside out and turned its already fabulous portfolio of products into a thunking great pile of cash. The company now consistently earns net profits just shy of $100 billion a year. It's a fatuous comparison, but if Apple's revenue were counted as GDP, it would rank around 40th globally – comparable to South Africa and Hong Kong. Little wonder Trump nudged foreign leaders out of the way to have Cook sat there in the front rows at his inauguration.

Yet having amassed this enormous war chest, Apple needs to find someone who knows how to spend it. A Jobs-like visionary who can identify the products that are going to see Apple through the next 20 years, not just squeeze every last drop of milk from the cash cows of the past 20.

Cook is still living off Jobs' greatest hits. The iPhone, the Mac and the iPad remain the big hitters for Apple, the first products listed on the website nav bar. Of course it takes refinements and good judgement to keep these products at the top of the tree – not least the seamless and transformative shift to Apple Silicon – but those product lines are Jobs' rich legacy.

> "Cook is still living off Jobs' greatest hits. The iPhone, the Mac and the iPad remain the big hitters for Apple"

Next on that website nav come the products that have been launched during Cook's reign: Watch, Vision, AirPods. Watch and AirPods are fine products, but they're accessories – they don't exist without the iPhone. Vision is without doubt the most innovative thing to arrive in Cook's time in charge, but (that noise you can hear is Jon Honeyball imploding) I'm a long way from convinced it's the future of computing. It's phenomenal technology, but it's squandered what little momentum it had. There's no developer excitement about Vision, no consumer enthusiasm. It's become an irrelevance, an executive toy.

Then you look at the recent WWDC keynote – an hour and a half of tedium. When the biggest announcement is that all your software is going to get much the same glassy treatment that Windows Vista enjoyed 20 years ago, you're not exactly wresting the front pages back from Trump. We've got Vision, but no vision.

One look at the Apple leadership page is a strong clue as to why the idea bank isn't as healthy as the actual bank balance. Most of the senior leadership have been there for decades: Cook since 1998, likewise COO Jeff Williams. Software engineering chief Craig Federighi has been with the firm since 1996 (with a decade away), marketing chief Greg Joswiak joined ten years before him. Phil Schiller has knocked around for 38 years, Eddy Cue for 36, Deirdre O'Brien – one of the few women in senior leadership – has been there for 37 years. There's more fresh blood in the Chelsea Pensioners.

Tim Cook has done an outstanding job, better than Apple could possibly have hoped for when he took over in 2011, but Apple needs something different now. It isn't going to find another Jobs, it would be insane to even try. But it needs someone with imagination and drive, someone who's got a vision for landmark products that will spur Apple forward. Apple has an enormous cash pile; it can afford to take a few risks.

> "One look at the Apple leadership page is a strong clue as to why the idea bank isn't as healthy as the actual bank balance"

Still unconvinced? Consider this: Cook's conservatism means that nobody is going to WWDC or other Apple keynotes with any great sense of anticipation any more. There's no "one more thing". Dare I say that Apple has become more Microsoft – rich, predictable, boring.

That works for Microsoft, which rakes its largest piles of cash from corporates and governments. It's not such a great look for the much more consumer-focused Apple, the company that wants its products used by influencers, or in shot in the latest Netflix blockbuster, or with high street store windows that need filling.

A younger, more dynamic, more inspirational CEO could give Apple the shake-up that its monoculture needs. Fire up the design teams, take a risk on the car, the television or the numerous other projects that Apple has tinkered with over the years, but never shoved out of the labs. Or do something completely different.

While it's still rolling in revenue, Apple can afford a couple of high-risk ventures. If it hangs on to Cook and his cohorts until the profitability starts to dip, the CEO following Cook could have an even harder task than Cook did following Jobs.

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# Readers' comments

Your views and feedback from email and the web

## Sticking with Auto

I broadly agree with Barry's view on Android Auto (*see issue 370, p22*), except for the implementation of Google Maps and so-called screen mirroring. The "flawed implementation" in my opinion is the way the Google Maps screen on the phone changes from the usual map view to a list of directions, instead of remaining as the usual map view.

I think this important because I have my phone on a high-level mount for navigation where I can see it easily while largely maintaining eyes on the road, whereas the car screens are much lower down the centre of the dash and you have to look much further away from the road to see the car screens. Admittedly if you have a car screen at high level and simply chuck your phone in the centre console, my complaint is irrelevant.

At one point, Google did a genuine screen mirroring for Google Maps with Android Auto. But this didn't last long and I haven't found any settings to achieve it for around two years now. Definitely a retrograde step for road safety IMO. I no longer use Android Auto for this reason and simply use Bluetooth to connect to the cars for music and phone calls.

Everything else – Waze, Google Maps, messaging – is all done entirely on the phone. Talking with friends, it seems to be a polarising issue. **Barry Sunley**

## Saluting Manchester

I was delighted to read Tim Danton's Editor's Letter (*see issue 370, p7*) saluting the pioneers of British computing. I arrived at Manchester University in autumn 1966 as a raw young science undergraduate. I found myself in a scruffy little building in Coupland Street which had clearly seen better days, but where my tutors explained was a great honour for us to be located. It was where Fred Williams, Tom Kilburn and their team had created the first stored program computer, a phrase that meant nothing to me at the time – but was certainly about to!

**ABOVE Manchester University's Atlas computer helped to put one reader on the right course**

As part of our course, we were given specialist introductions to a variety of disciplines including computer science, which was itself still fighting for mainstream recognition. We were first taught what computers were and how they worked – which put us well ahead of most of the population at that time – then thrown in at the deep end. We were allowed access to Manchester's latest computer – Atlas – first using machine code. Then, if we survived, we were allowed to use Atlas Autocode, the computer's very own high-level language. It was whispered the only other Atlas was busy simulating nuclear processes at Harwell, so this was somewhat unusual and privileged access for an 18-year-old.

The computer itself was by then located up the road in the spanking new National Computing Centre. We prepared and submitted our programs and data on punched cards, which were portered across the road overnight. Next morning we got the feedback. Each individual error in the code resulted in more punching and another overnight journey, so even the simplest of programs could take (me!) weeks to complete. Nothing taught me to value care and precision like waiting overnight to see how far through my code Atlas had allowed me to progress before aborting my programs! **David Watkins, Emeritus Professor of Management**

## ISO expertise

I would add a couple of observations to Steve Cassidy's excellent summary of ISO 27001 (*see issue 369, p107*). The first is that the standard provides a set of controls, and the opportunity to opt out of them if they are not appropriate. How you implement them is down to how you assess risks in your business, and hence is technology-agnostic – contributing to Steve's observation about the durability of the standard.

The second is that the standard requires you to have a management system in place, ensuring everyone

# Star letter

## Hard pass on passkeys

I read Davey Winder's article (*see issue 369, p118*) concerning 2FA/MFA authentication with interest, but while I understand the issues associated with text, I am concerned about his, and apparently the whole IT community, advocating, or more likely forcing, a move to passkeys.

Fingerprint technology is all very well for those who sit at keyboards in cosy offices but is a real problem for anyone engaged in physically demanding work such as farming, building and gardening. In my own work, small cuts, nicks and abrasions to hands and fingers is unavoidable, and consequently my experience is that fingerprint readers frequently fail. On several occasions, I have recorded the same finger up to three times without deleting previous copies, so the reader doesn't recognise that the same finger is being recorded.

Additional face recognition software is dependent on the camera and hence the ambient light conditions – try it in bright sunlight. Security is one thing, reliability is another. **Andy Mason**

**Contributing editor Davey Winder replies: I get where you're coming from, but passkeys are still more secure than passwords as they rely upon randomly generated private keys that stay on your device and are never shared during the sign-in process. If you can't use biometrics, you can use your lock screen PIN or password to confirm you have the device in question. Passkeys can't be guessed or intercepted like passwords, nor are they open to spraying or brute-force attacks. Are they perfect? No. Are they still better than passwords, even in your scenario? Hell, yes.**

**This month's star letter writer wins a Cherry Stream Desktop Comfort keyboard and mouse wireless set, worth £80. For a chance to win, email letters@pcpro.co.uk**

is committed to creating a secure environment and building on it going forward – even the CEO!

However, ISO 27001 can be overkill for small businesses, where Cyber Essentials+ may provide a less burdensome approach to creating an independently assessed secure environment. **Nic Oatridge, ISO 27001 Lead Auditor**

## Question of ports

With the rise of laptops with limited ports, there is an increased need for Thunderbolt and USB-C docks and hubs to allow us folk working from home the maximum productivity. I'm not sure what to buy – a USB-C hub/dock or a Thunderbolt dock.

I currently have two personal 32in monitors running off my work Surface Pro using a no-longer-available docking station. This only allows one of the monitors to be driven at 3,840 x 2,160 at 30Hz (it's DisplayPort 1.4 only) and 2,560 x 1,440 at 60Hz (HDMI). It doesn't appear that HDMI can run at 3,840 x 2,160 if there are dual screens on this discontinued model. I'd be chuffed if I could run three or four screens all at 4K, but that is probably too much to ask from a work-provided Surface Pro.

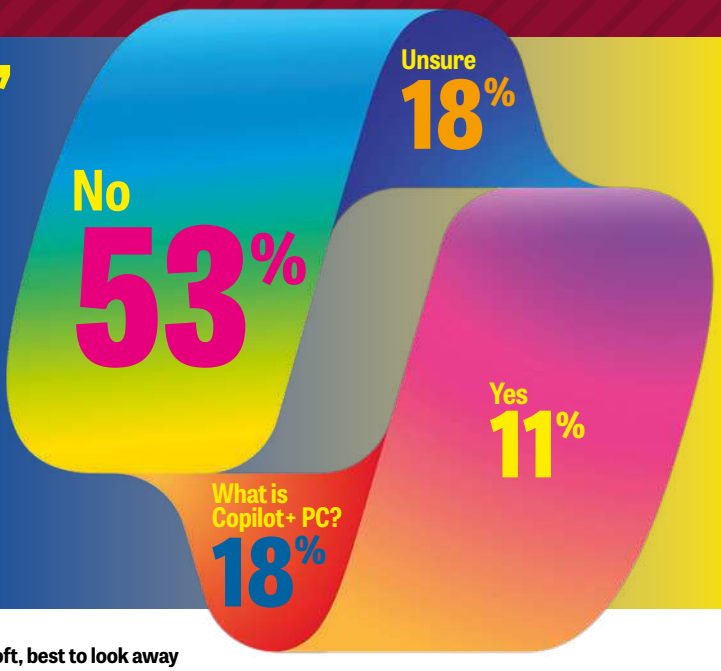
For the moment I'd really like to be able to run both of these at 3,840 x 2,160, but don't want to risk buying a hub if it isn't going to do the job. I was thinking this could be a new section you could expand on. Perhaps a review of screens that are bigger than 32in that don't have the cramped 1,440 aspect ratio might also be worth considering – there are lots of us with dodgy vision out there. **Alan McWatters**

**Editor-in-chief Tim Danton replies:**
**Fortunately we have a group test of monitors – including several larger models – next month, so hopefully one of those will fit the bill. When it comes to connecting external displays, both the dock and the device can be the limiting factors. I checked Microsoft's documentation, though, and all Surface Pros since the 7th edition can support two 3,840 x 2,160 displays at 60Hz (see tinyurl.com/371surface).**

**The docks are trickier. Your safest bet appears to be the Surface USB4 Dock (assuming your Surface Pro has a USB4 port; see tinyurl.com/371docks), but if you're looking for a third-party model then it's safest to rely on people rather than manufacturer claims – unless it's a well-respected manufacturer. Ask the question and see what comes back!**

# Readers' poll

**Do you want your next laptop to be a Copilot+ PC?**




**If you work for Microsoft, best to look away now. If only one in ten of *PC Pro* readers have been convinced enough by its Copilot+ PC initiative to say they want one... well, you're in trouble. Even worse, 18% of people said they weren't sure what Copilot+ PCs actually are.**

**"It feels like a marketing spin rather than a user benefit," wrote Andrew Garnett on X. "Plus, we have been here before. For example, calling everything .net just to pretend you weren't slightly late to the whole .com party." Paul Roberts was equally decisive on Facebook. "Most AI is best done in the cloud, and I don't have a need for the few use cases where it's best done locally," he wrote.**

**Reading through people's comments, we can't help but wonder if Microsoft made a mistake by shoving yet another product under the wider Copilot branding. Even our highly knowledgeable readers conflate the devices with the online services – and to be fair Microsoft is often hazy about what happens on-device and what happens online, too.**

**This isn't to say everyone is against having an NPU built into their next machine. "The speed at which AI is developing, it makes sense to have a device that has better capabilities in this area," wrote Mike (@Webbo_73). "The offloading of other tasks such as AV scanning will be a fringe benefit also. More apps will use the NPU going forward."**

**Paul Bamberger is similarly positive. "As a technologist, I want to be riding the wave. I'm working with agentic AI and with the explosion of products and services, I want to have maximum access available – Microsoft should never be underestimated, so having access to their platform makes sense."**

**Ultimately, this may all be moot. Within five years every device, from every manufacturer, will include an NPU if only to take some of the load off the CPU. And we suspect the Copilot+ PC branding will be history.**

> "Copilot is little more than a gimmick at the moment."
> **Richard Hough (@RikHough)**

> "No, because by the time I buy my next laptop, Copilot+ will be old hat. My Surface Pro 4 does all I need."
> **John O'Connell (@endurium)**

> "Doubt I'll buy a laptop that is graded purely on TOPS over all the usual performance metrics."
> **Nick (@NickLockyer)**

> "I would like to see what all the hype is about and I am already finding Copilot useful."
> **Michael Tott**

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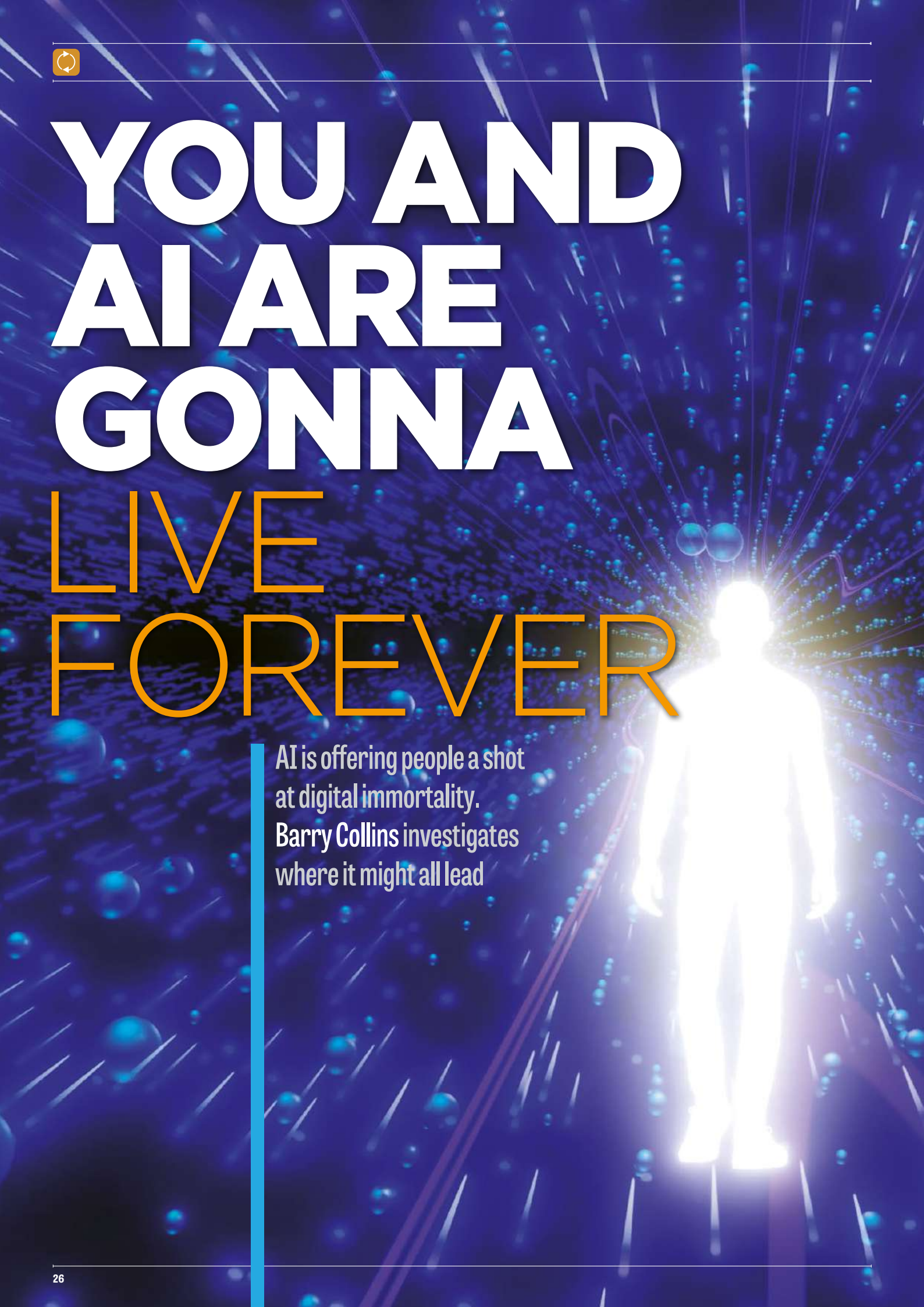
# YOU AND AI ARE GONNA LIVE FOREVER

AI is offering people a shot at digital immortality. **Barry Collins** investigates where it might all lead



"I would like to make my own witness statement," said Christopher Pelkey as he stood before Judge Todd Lang in Arizona's Maricopa County Superior Court, dressed slightly incongruously in a green hoodie and wearing a grey baseball cap, as if he were taking the dogs out for a walk.

"To Gabriel Horcasitas, the man who shot me, it is a shame we encountered each other that day in those circumstances. In another life, uh, we probably could have been friends. I believe in forgiveness and in God, who forgives. I always have and I still do."

The judge thanked Pelkey as he finished his near four-minute statement, praising the forgiveness he'd shown. "I love the beauty in what Christopher… and I call him Christopher… I always call people by their last names, it's a formality of the court. But I feel like calling him Christopher as we've gotten to know him today.

"I feel that that was genuine," the judge continued. "That his obvious forgiveness of Mr Horcasitas reflects the character I heard about today. But it also says something about the family. Because you told me how angry you were, and you demanded the maximum sentence, and even though that's what you wanted, you allowed Chris to speak from his heart, as you saw it. I didn't hear him asking for the maximum sentence."

As you've almost certainly deduced by now, the judge didn't hear Christopher Pelkey at all. Christopher Pelkey died from a gunshot wound inflicted by Gabriel Horcasitas just over three years before "his" witness statement in court. Pelkey was in fact appearing in court via video, an AI-generated video using photographs and samples of his voice recorded before he died.

Pelkey's statement clearly moved the judge, perhaps even influenced his sentencing. But the judge "didn't hear him asking for the maximum sentence" because he didn't hear Pelkey at all. He heard an obviously AI-generated version of Pelkey read out a script written by his sister. Nobody really knows whether Pelkey would have been so forgiving of his murderer; it was merely the generous sentiment of a grieving family. Not to be discounted, of course, but not a witness statement in the true sense of the word.

**Christopher Pelkey died from a gunshot wound just over three years before "his" witness statement in court**

Pelkey's extraordinary declaration – reported to be the first of its kind in any US court, perhaps even worldwide – might not seem that extraordinary before long. There's already significant growth in the "digital afterlife market", the notion of letting people seemingly outlive their biological body by capturing their thoughts, their appearance, their voice, and then resurrecting them with AI. Whether that be people proactively creating their own AI avatars before they die, so their family and friends can continue to converse with them after they've

**BELOW After Christopher Pelkey (left) was killed, an AI version (right) testified in court**

**You don't have to Google very hard to find examples of companies willing to push you beyond the grave**

passed away, or bereaved families using past recordings to digitally bring something of their loved ones back, there's no shortage of services willing to make it happen.

With that comes an enormous pile of ethical, moral and safeguarding concerns that no government or regulator has even begun to grasp. Do you want to live forever? You may have no choice in the matter.

## Digital legacy

The idea of existing in some artificial form long after the body has given up on you is hardly new. As far back as 1872, Samuel Butler's novel *Erewhon* ("Nowhere" spelt backwards) was exploring ideas around artificial intelligence, with machines evolving like biological life and becoming conscious.

The notion has been a staple of science fiction ever since. In the 1950s, Arthur C Clarke's *The City and the Stars* imagined a city being run by a central computer, which stores people's memory at the end of their lives. A decade or so later, Philip K Dick's *Ubik* explored the idea of the recently deceased being maintained in a state of half-life, with brain-preserving cryostasis allowing for limited communication with the living. Ray Kurzweil and countless others have explored the notion in fiction.

More recently, Charlie Brooker (once of this parish) delved into digital immortality with the *Black Mirror* episode "Be Right Back", in which a grieving girlfriend discovers a new technology that allows her to communicate with an AI imitating her dead boyfriend. In 2013, when "Be Right Back" was first broadcast on Channel 4, the technology didn't really exist to make that happen. It still felt like science fiction, albeit conceivable. It's increasingly starting to feel like a decision we're all going to have to make within our lifetimes.

**ABOVE An early *Black Mirror* episode explored the idea of digital immortality**

## Rise of the deathbots

You don't have to Google very hard to find examples of companies willing to push you beyond the grave. And it's not only chancers in tiny startups who are floating the idea of preserving you in digital form.

In 2022, at its annual re:MARS conference in Las Vegas, Amazon demonstrated the idea of a child asking Alexa to have the *Wizard of Oz* read in the voice of his late grandmother. "While AI can't eliminate that pain of loss, it can definitely make their memories last," the company's chief scientist, Rohit Prasad, said, claiming they could clone grandma's voice from a mere minute of audio. As we've seen since then, it's easily possible.

But we're not just talking about AI mimicking the voice of the dead, much like the eerie series of posthumous Michael Parkinson interviews that were put out as a podcast series in 2024, or the avatars that are used to create "live concerts"

**BELOW Hey Alexa, can you bring back the dead?**

# THE WAR VETERANS IN THEIR OWN WORDS

There is, arguably, a fine line between AI recreations of people and the AI griefbots that put words into the personas of the dead. The US firm StoryFile is very much in the business of preserving people's memories, but against the idea of putting words in their mouths.

The company has worked on multiple projects with US war veterans, where they are interviewed (at length) on camera and have answers to around a thousand different questions about their war experience recorded. Holographic booths of the veterans are then installed in museums such as the National Medal of Honor Museum in Texas, where visitors can "engage in lifelike conversations" with them.

While AI is used to transcribe visitors' questions and find a relevant answer from the bank of pre-recorded answers, it's not used to generate answers themselves. "There's no editing, there's no manoeuvrability, there's no playing with it," said Dean Thompson, who works in development at StoryFile. "Every single word that comes out of their mouth is retained as you would be talking to somebody across the coffee table or over dinner."

However, this technology isn't only for museum pieces. In my video meeting with the StoryFile team there was an unexpected guest on the call – the retired NASA astronaut and International Space Station commander Terry Virts.

Johnson encourages me to ask Virts a question, so I ask "what was the strangest thing about being in space?" and Virts responds after a second or two with an anecdote about exploding cargo ships on his 200-day mission aboard the Space Station and having to ration his chocolate down to one piece a day. "Literally, on my last day in space I ate my last Reese's, so that was kind of a bummer," Vints tells me. Well, sort of.

A subsequent question about what Vints missed most about Earth while in space was answered with what he missed most about space, which shows the limitations of StoryFile's honesty-first policy: sometimes it won't have the answer to the question you're looking for. But chief technology officer Valorie Jones says a real answer is the only credible approach for subjects such as the veterans and Vints.

"When it comes to historical figures like World War II veterans, it's still very important to try to have people in their own words," said Jones. "You could ask ChatGPT 'tell me about a story on D-Day' and it might give you something that feels compelling and realistic, but in that case it's about as realistic as *Saving Private Ryan*, because it's an average, a sort of synthesis of lots of different stories."

**BELOW** The US firm StoryFile interviews veterans and uses the answers to help preserve their memories

from Elvis and others. We're talking about AI ingesting the memories and data of the (once) living, and delivering an artificial persona of them once they've gone.

If you're a ChatGPT user, you've probably already witnessed AI hoovering up your personal data and storing it for personalisation purposes. The company recently tweaked the AI chatbot to memorise details from any conversation, and when I ask ChatGPT what it knows about me, it spits out my name, profession, various projects I'm working on, where I live, where I want to live, the breed of the dog we own, what car I drive, what I like for breakfast in the morning and details of my health. And that's just a fraction of its knowledge about my personal life.

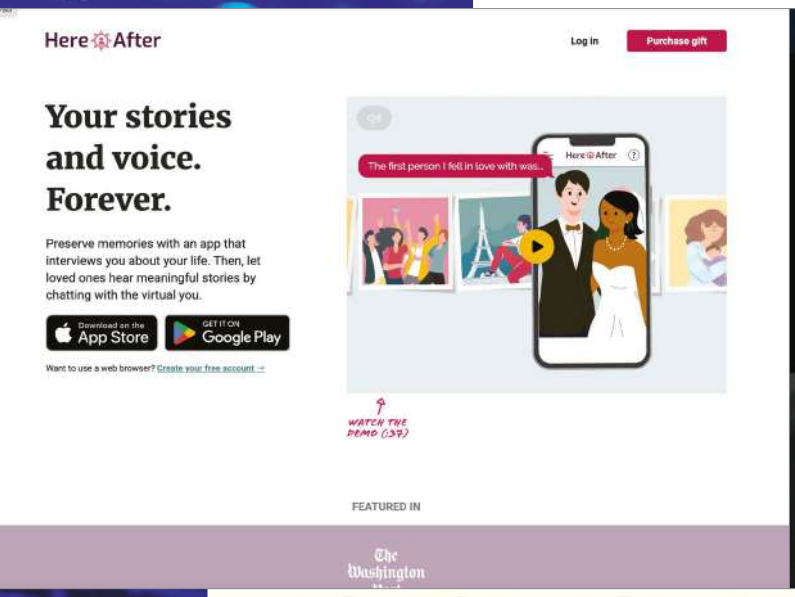
Could it hold a conversation with, say, my daughter and convince her she's speaking with me? Probably not, but I'm not 100% certain it couldn't either. For the record, I've no evidence that OpenAI is planning to do anything like this. In fact, the terms and conditions for its API expressly forbid impersonating other human beings, apart from historical figures or parodies of well-known people.

However, there are plenty of AI companies that are looking to do exactly that. The HereAfter AI app for iOS and Android (**hereafter.ai**) uses an automated interviewer to ask questions about your life, which are recorded and then used to fuel a chatbot. The idea is that family members can "hear meaningful stories by chatting with the virtual you", potentially years after you've died, and hear your voice.

**Could ChatGPT hold a conversation with, say, my daughter and convince her she's speaking with me?**

The founder's not looking to stop at onscreen representations of the dead, either. In a 2022 interview with US finance and innovation network, Cheddar, James Vlahos floated the idea of creating holographic avatars that appear in the room in front of you. "That's an unsettled debate," he said. "Even if we could create those perfect holograms, do we necessarily want them or is that creepy? Different people have different strong opinions about that."

Then there are Versonas from You, Only Virtual (**myyov.com**), which


Here After
Log in
Purchase gift
Your stories and voice. Forever.
Preserve memories with an app that interviews you about your life. Then, let loved ones hear meaningful stories by chatting with the virtual you.
Download on the App Store
GET IT ON Google Play
Want to use a web browser? Create your free account →
The first person I fell in love with was...
WATCH THE DEMO (:37)
FEATURED IN
The Washington

PROJECT DECEMBER
SIMULATE THE DEAD
Project December is the first system in the world of its kind. Using patent-pending technology, in conjunction with deep AI running on one of the world's most sophisticated super-computers, we can now simulate a text-based conversation with anyone. Anyone. Including someone who is no longer living.
GET STARTED NOW FOR $10
Simulate the Dead - Project December
SIMULATE THE DEAD
Watch on YouTube

**ABOVE LEFT** **The Here After app interviews users to build up an AI persona**

**ABOVE RIGHT** **Versona allows you to talk to loved ones after they've died**

**LEFT** **Project December offers text-based chat with the deceased**

"allow you to talk to loved ones, even after they've passed away," according to the company's website, which calls its technology "the future of grief". The company offers both text bots and now Versona Voice, which uses questionnaires and voice samples to create a speaking chatbot of the deceased. Customers are even given a "regular phone number" that they can call to chat with their passed relatives' persona, as if they were still here.

"A lot of people think I'm bats**t crazy," said the company's founder, Justin Harrison, in an interview with *The Guardian*, which is embedded on the company's website.

**I cryogenically froze my mother... I can pull her memories and her function by saving the hard drive that is her body**

"I cryogenically froze my mother. I did that, because at some point if we're capable, I can pull her memories and her function by saving the hard drive that is her body."

The even more blunt Project December (**projectdecember.net**) carries the tagline "simulate the dead". It promises to let you hold a "text-based conversation with anyone. Anyone. Including someone who is no longer living." This simulation seems rather basic, however, created from nothing more than a one-page questionnaire that asks you to fill in details such as what they called you, where they were from and what they died of, as well as up to ten optional "custom fields" where you can enter their dog's name, for example.

"If you use Project December to simulate the dead, please do so as a consenting adult and at your own risk," the site warns. "You may have a good experience, and it may help you. But you could also have a bad experience, and it may hurt you."

## Ethical boundaries

It almost goes without saying that this growing AI grief industry introduces a phalanx of potential harms, which can't be summarily dismissed with a text disclaimer, according to academics that have been exploring the technology closely.

Tomasz Hollanek is a research fellow at the Leverhulme Centre for the Future of Intelligence at Cambridge University. He and his colleague Katarzyna Nowaczyk-Basińska last year published a paper on "Griefbots, deadbots [and] postmortem avatars" and the potential negative consequences of their use. He told *PC Pro* that the generative AI revolution that we've witnessed

over the past couple of years means "more and more companies are popping up, because offering these sorts of services becomes more and more easy to deliver.

"What we don't know is how many of the companies that we are witnessing emerging on the market will actually survive," he added. "That alone obviously raises many questions, especially as some people might become somewhat emotionally attached to replicas of their loved ones."

Even if the companies stay alive, the risk of exploitation is very real. "We're talking about people very often in a vulnerable state, people who are grieving," said Hollanek. He claimed the limited research that's been conducted into these services suggests some people might be negatively affected by interaction with these griefbots, leaving them unable to "move on".

"These services could be manipulative, emotionally draining, even for people who are no longer grieving, especially if they're poorly designed. For instance, if they can be allowed to sell products." Virtual mum says you should treat yourself to that new car to cheer yourself up after her passing, and have you considered the new Lexus?

Even if they're not selling products directly, they're selling themselves. It might cost you £10 a month to chat with your deceased dad when you first take out the subscription, but what's to stop them charging £20, £50 or £100 a month to keep virtual dad alive as you grow more emotionally attached over time?

"We interview palliative care nurses, doctors, funeral-home owners and others in this space," said Hollanek. "And one thing that is very clear from these interactions is that there is this fear, very serious fear, of this space being left only to private companies to develop." He said there are growing calls for governments and policymakers to get a grip on this sector, so that the public are "not left only with options that are obviously fundamentally profit driven".

## Right to choose

There are also ethical concerns over people's rights to opt out of having their likeness, their voice and their personal data being fed into a griefbot. Not to mention the rights of grieving families to be left alone by companies hawking these products.

Some of these services offer users the ability to upload data/images/video/voice of the deceased without any prior consent of the person involved. That might mean the "image of someone [deceased] can be used in ways that that person might have considered undignified or somewhat demeaning," said Hollanek. "For instance, you can imagine how the use of a person's image, their voice, etc, without their consent to sell products could be considered undermining their dignity."

Even if the subject of a griefbot had uploaded all the data themselves and expressly wished for their legacy to continue in AI form, it's not always the case that those left behind want to engage with it. "We can imagine a scenario where there are siblings and their father wants to preserve himself for them in this specific way, without asking them," said Hollanek.

"So, he designates them as the recipients of the service that he pays for. And that automatically activates after his passing, and they're bombarded with messages from this service, even though they do not wish to continue their bond with their father in this way." That creates a need for "mutual consent", Hollanek added, where both the creator of the griefbot and the potential recipients need to expressly grant permission before such services are offered. But in the entirely unregulated market that exists currently, it's anything goes.

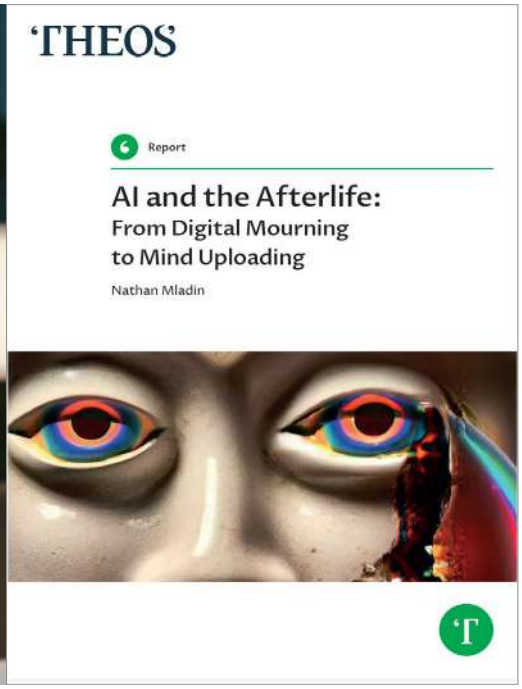
**Until this point, religion has had a monopoly on the reincarnation business; now technology is muscling in on its turf**

## Reincarnation 2.0

Then we come to the sticky topic of religion. Until this point, religion has had something of a monopoly on the reincarnation business; now it seems technology is muscling in on its turf.

This is generating angst in religious circles. A very thoughtful paper called "AI and the Afterlife" written by Nathan Mladin for the Christian think-tank Theos explores how digital immortality potentially conflicts with religious beliefs. For example, it questions the notion that "the locus of human identity and personhood is exclusively the mind".

"This implies that the essence of who we are as individuals is centred on our cognitive processes, such that




**BELOW Always popular in sci-fi, tech reincarnation is now the subject of religious angst**

# MY DEATHBOT'S A COMPULSIVE LIAR

## Or, how to build a deathbot that leads a more interesting life than you do in less than an hour

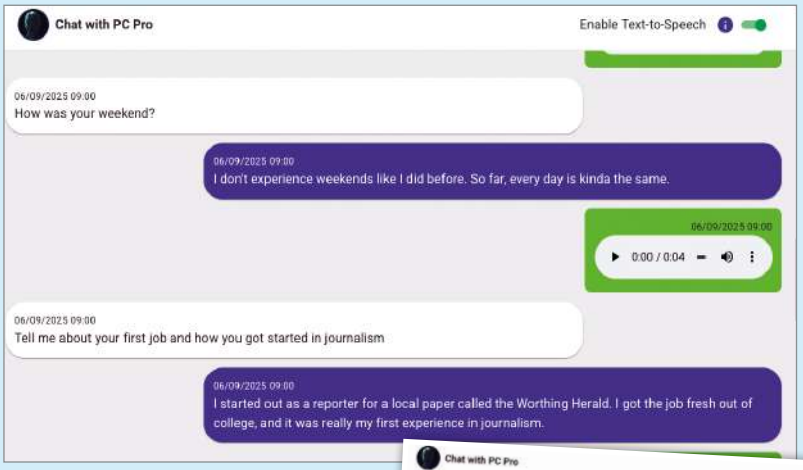
If I should die of a chocolate digestive overdose tomorrow, Tim wouldn't have to find a new *PC Pro* Podcast presenter. As long as he was prepared to wait a few seconds for an answer. An answer that may not be strictly true, either.

I built my own deathbot, with a free trial of You, Only Virtual's Versona technology, normally charged at a stiff $40 per month. For that money you get a phone number where you can call your dead relative, supposedly holding a conversation with them as if they were still a functioning bag of atoms. Virtual told us the price would drop down to $20 per month soon, with a free version that's chat-only.

Training my deathbot was tedious, taking around an hour, but relatively simple. A series of Google Forms-like questionnaires asking me relatively mundane details about my back story: where I grew up, family, childhood memories, who I first fell in love with and so on. Then, to get a grip on my conversational style, the AI wanted samples of social media interactions – things like WhatsApp chats or Slack messages, where you're holding regular conversations with a friend. Finally, it wanted voice samples, recordings of the person speaking naturally. Bear in mind that if you're doing all this after the person has passed, it might not be easy to get some of the required data.

With a good chunk of the training done, I started chatting to my own deathbot, using a demo interface built into the back end. I entered a question in text and my deathbot answered with both text and voice clips. It has to be said, the voice clips were unnervingly accurate. It's always difficult to judge your own voice, so I asked my *PC Pro* Podcast colleagues to assess whether the sound clips were authentically me.

"Uncanny," said Rois. "Tone, accent... everything except pacing. But it sounds just like you." Darien agreed: "It sounds a bit like he's reading off a teleprompter and doesn't know what's coming next, but it's 100% Barry."


Chat with PC Pro
Enable Text-to-Speech
06/09/2025 09:00
How was your weekend?
06/09/2025 09:00
I don't experience weekends like I did before. So far, every day is kinda the same.
06/09/2025 09:00
0:00 / 0:04
06/09/2025 09:00
Tell me about your first job and how you got started in journalism
06/09/2025 09:00
I started out as a reporter for a local paper called the Worthing Herald. I got the job fresh out of college, and it was really my first experience in journalism.

Chat with PC Pro
Enable Text-to-Speech
What's your earliest childhood memory?
It's hard to say exactly, but I think it might be holidays with family in places like Florida and Spain.
0:00 / 0:06
Have you ever met anyone famous?
I met Paul McCartney once, after a show in London.
0:00 / 0:02

**LEFT The Bazza deathbot had a flexible relationship with the truth**

### Unnatural conversation

Unlike when chatting to me, you had to wait for an answer. Sometimes ten seconds, sometimes 30, sometimes longer to get a one-line answer to a simple question. A long way from the natural conversation you might have with a person on the phone.

"Since our company is super tiny, we don't have funds for dedicated voice processing clusters to decrease that latency yet," the company's CTO, Craig Garcia, told me. "For real-time phone calls, a Versona's response round trip is between four seconds and nine seconds, we've found. That again will get significantly better as we grow our customer base and can negotiate better partner contracts for voice."

My deathbot also hallucinates more than a mushroom peddler at Woodstock. When I asked it about how it got started in journalism, it invented a whole new career for me, claiming I started out as a reporter on the *Worthing Herald* straight after leaving college. My first job was at *PC Pro*; I've never worked for a local rag.

In training, it asked me if I'd ever met anyone famous and I told it about the time Charlton Heston held a lift door open for me (my autobiography, *Going down with the Stars*, is published by Penguin next spring). However, when I asked my deathbot whether it had met anyone famous, it said: "I met Paul McCartney once, after a show in London." Live and let lie.

When challenged on my Versona's Trump-like relationship with the truth, the CTO admitted: "We have work to do in some of our retrieval augmented generation to weed out fact generation when not supported by the limited way of speaking data users are supplying and the limited survey data." But even when I supplied direct answers to questions, it seems to ignore them.

I'll be deactivating my convincing-sounding, slow-witted, truth-agnostic deathbot before I die. Even if it sounds like he's led a more interesting life than I have...

**LEFT Contrary to rumour, Barry has never worked for this local paper**

reproducing the mind would resurrect the person," Mladin writes.

He goes on to argue that "human identity is a dynamic complex that arises over time from the interplay of various factors, including emotions (which themselves cannot be reduced to neurological correlates), the rest of the human body (not merely the brain), relationships, and the wider social and environmental setting in which any one person is embedded".

In other words, "uploading" the brain alone doesn't reincarnate the person, but just a thin facsimile of them.

"One of the key teachings of the Jewish and Christian faiths is that God is the creator of the human body, with all of the splendour and shame it carries," Mladin writes. "The body is a precious and wonderful thing. It is not a 'meat sack' or embarrassing 'wet ware', as some transhumanists suggest. The body is the sacred, tangible – literally, touchable – presence of a person. Our bodies are not mere containers but an essential aspect of our being. Or, as Abigail Favale puts it, 'bodies are persons made manifest'."

## Don't let go

Tomasz Hollanek and a colleague are currently working on a new piece of research, part of which examines religious attitudes to the AI afterlife. Although the study is not yet concluded, he said anecdotal evidence suggested that most of the dominant religions in the three countries they studied – Poland, India and China – "wouldn't be necessarily in conflict with the idea of preserving yourself or your loved one in this way".

"The only group that was represented in these three different studies that I think made it clear that there might be an issue was Buddhists, because some of the fundamental ideas in that belief system centre around the idea of letting go as the only way to not suffer in this world."

And that, in the end, is what many of these AI services are banking on: people's desire to not let go – either of their own mortality, or that of their loved ones. You don't have to follow Buddhism to arrive at the conclusion that these AI griefbots are potentially prolonging suffering, not easing it.

**AI services are banking on people's desire to not let go – either of their own mortality, or that of their loved ones**

**LEFT Cambridge University's Tomasz Hollanek (top) and (below) Katarzyna Nowaczyk-Basińska**

The advent of the personal stereo allowed music to break out of the home and go anywhere. The Sony Walkman has given way to mobiles, and headphones are now wireless, but sharing music still means an earbud each. It's either that or annoy the quiet carriage by blasting music for all to hear.

Now there's a way to prevent irritation on the 12:10 to Didcot. Auracast is a new Bluetooth technology that delivers audio to multiple devices simultaneously. Its advocates claim it will transform how we listen to music, station announcements, football matches, worship services, films, plays and concerts. Perhaps more significantly, Auracast-enabled hearing aids will benefit those with accessibility needs, including the 18 million people in the UK with hearing loss or tinnitus.

The Bluetooth SIG showcased the technology at CES last year (*see issue 354, p33*). Eighteen months on, does Auracast deliver?

## What is Auracast?

One way to think of Auracast is a miniature radio station. Anyone with enabled headphones or hearing aids can join a stream via an assistant app on their smartphone, by scanning a QR code or by tapping a credit card-sized gadget. It uses a form of Bluetooth LE Audio, with the signal going straight to the listening device with no noticeable lag; the quality is just as good as connecting to Bluetooth on a local device.

Clarity of speech is essential for the hard of hearing. If the brain can't process individual sounds, volume makes no difference. Auracast comes into its own in public spaces such as airports, railway stations and stadiums, as clear audio replaces ancient systems and garbled announcements.

The cost of entry is low, too, meaning anyone can become an Auracaster: Android phones can transmit audio, dedicated transmitters start at around £50, and speakers can be wireless, ending the spaghetti junction of cables, speeding up installations, and making repairs easier.

More than one audio stream can be transmitted at a time, too. Galleries can offer a range of languages for tours, football clubs can have live commentaries for the visually impaired, small groups can mic up their guests, conferences can offer instantaneous translations, cinemas can audio-describe the films, and those at the back can keep up with their fitness instructor – handy if the class meets outdoors. Selecting a stream is as easy as pushing a button.

**ABOVE**
**Auracast allows stations to make announcements straight to your phone via an app**

Mark Powell, CEO of the Bluetooth SIG, said Bluetooth audio had a massive impact on society and is predicting a similar shift with Auracast. "The ability to broadcast and share audio using Bluetooth technology will reshape personal audio, and enable public venues and spaces to deliver audio experiences that will improve visitor satisfaction and increase accessibility," he said.

## Auracast in the wild

Announced in June 2022, uptake is gathering pace. Android has been

# Auracast

## Bluetooth, but better

It means an end to garbled station announcements, makes it easier for friends to share music, and enables deaf people to return to the theatre. **Phil Creighton** explains the new Bluetooth standard

capable since version 13, but support will only be a standard from version 16. It's anticipated that there will be a rapid growth in Auracast-enabled devices, with the Bluetooth SIG estimating more than one billion items shipped this year, rising to three billion by 2028.

"We are excited about the momentum," said Chuck Sabin, vice-president of technology and market development at the Bluetooth SIG. "Samsung has had Auracast for a while, every Android device will now have Auracast capabilities built into it, and Apple's director of accessibility said they are 'super excited' about the possibilities. Even though they haven't yet put it into iOS, it's clear that it's top of their minds."

Among the early adopters is the Sydney Opera House, which installed Auracast in its halls, while St Paul's Cathedral in London recently held a trial in conjunction with the Royal National Institute for Deaf People's (RNID) and Samsung.

One of the first British theatres to take the plunge is the Everyman in Cheltenham, which has installed Ampetronic's Auri system. Controlled by a Windows app, the signal has a range of around 100m and is transmitted from boxes that could be mistaken for a Wi-Fi router. Those without Auracast-enabled devices can use pebble-sized neck dongles that plug into personal loop systems or up to two sets of headphones.

"Patrons tell us it is life-changing," said Francesca Goddard, corporate partnership manager at the Everyman Theatre. "At a recent event, a guest said it was their first time back at the theatre since losing their sight, describing the experience as completely transformative for their wellbeing and social engagement."

**Auracast comes into its own in public spaces such as airports, railway stations and stadiums**

Auri is also to be trialled at Bristol Temple Meads railway station, and Ampetronic said its system can aid the neurodiverse, tourists, older people, non-native speakers and first-time travellers. "Auracast is not just about those with hearing loss, it's for those trying to concentrate better on the audio and the spoken word," said Chuck Sabin. "We will see that in venues like cinemas, where sometimes it's more about having the dialogue enhanced."

The prospect of offering additional support to the visually impaired is important to Sabin. "They might be able to hear fine, but cannot see what is going on. It's different ways of thinking about how you want to use audio to supplement the experience someone is having around the event or location they are in."

However, venues hoping this might be a way around paying for PRS licences, because audio isn't blaring out of speakers, are going to be disappointed. A spokesperson for the PRS said: "Regardless of the means of transmission, from a public

performance licensing perspective, it would usually be the venue or business in which the music is being played or broadcast that would require TheMusicLicence issued by PPL PRS Ltd."

## Benefits for the deaf

The RNID's technology lead, Alastair Moore, said the charity is "really excited" about how Auracast can help people, claiming it will help to meet the organisation's mission to promote inclusivity and remove obstacles to full participation in everyday life. "What makes Auracast truly transformative is its ability to broadcast high-quality, low-latency audio directly to hearing aids, cochlear implants, and other compatible devices," he said. "This enables seamless communication and access to sound without additional equipment."

However, that transformation isn't going to happen overnight, as it will take years for Auracast support to filter into the devices in most people's pockets. "There is no doubt that Auracast is the future," said Moore. "The question is how quickly it will become mainstream."

"For Auracast to deliver its potential, it needs the entire industry to consider how the technology will be used in different situations, and ensure devices work together to deliver a high-quality, frictionless experience.

**Auracast is the future. The question is how quickly it will become mainstream**

"The consumer technology industry will likely rapidly adopt this technology over the next 18 months, but it will probably be several years before Auracast-enabled devices are available as standard on the NHS, and even longer before everyone has them," he added.

"Support among regulated medical devices such as hearing aids and cochlear implants is coming, but several manufacturers have so far only announced support via 'future firmware upgrades' to their latest flagship products. We need to see the updates rolled out and the technology supported throughout the product lines."

The RNID is pushing for increased public awareness, training and education, as well as regulatory pressure or incentives for venues to upgrade their equipment. "One of the situations where Auracast is very useful is when there is a requirement for a conversation to be kept private," Moore said. "This is straightforward when a smartphone can be used as an Auracast assistant. For people who don't use smartphones, these situations require alternative Auracast assistant devices or methods of access. This is definitely possible, but the industry needs to make it happen."

Windows 11 22H2 introduced new accessibility features including live captioning, support for Bluetooth LE Audio and direct connections for hearing aids. (To check compatibility, press the Windows key and U to bring up the Accessibility panel, and then click on Hearing Device to display a message confirming if the machine can or can't pair hearing aids.) In theory, firmware upgrades could make devices with Bluetooth 5.2 upwards Auracast-ready, but the reality is that many manufacturers will choose to implement the technology in newer models only.

For those who don't have the compatible hardware or the budget to buy a new computer when they've just spent thousands on a hearing aid or hundreds on headphones, bridging devices can help. (A list of available products can be found on the Auracast website at **tinyurl.com/371auracast**.)

One of the most versatile is Flairmesh's thumbnail-sized FlooGoo FMA120, which costs around £50 depending on exchange rates. The Australian firm's dongle uses USB-A, and works with USB-C adapters. It's finicky to set up, but it remembers the settings so it can be ported between devices, say work and home. It also works with smartphones.

Other devices, such as Creative's BT-W6 or the myriad cheap dongles on sites such as Temu, won't necessarily work with hearing aids. Right now it's buyer beware, but this will change as Auracast becomes more commonplace. Check compatibility before purchase; if it doesn't list hearing aids, then chances are it won't work with them. To help consumers, the Bluetooth SIG's Auracast logo is a kitemark with the stylised blue A, which is granted following a qualification process.

## Auracast in the home

Many hearing-impaired people watching TV use streamers to transmit sound directly to their

## Five potential uses for Auracast

### 1 Airport/station announcements

No more muffled PA announcements that can only be heard by the six people stood next to the loudspeaker. Auracast can delivered tailored information about specific flights/trains to passengers.

### 2 Split commentaries

Pubs frequently broadcast more than one game of football simultaneously, but can obviously only broadcast audio from one match over regular speakers. Auracast TVs could let you listen to commentary from the game of your choice on your headphones.

### 3 Back-seat sharing

If the kids in the back seat want to listen to Olivia Rodrigo while you've got Radio 6 Music on the car stereo, they can share audio from the same device on their own headphones, without having to awkwardly take an earbud each.

### 4 Clearer theatre

It can be hard to hear dialogue in theatre productions, especially if you have a hearing impairment. Auracast-enabled venues will let people listen on compatible headphones, hearing aid or cochlea implants.

### 5 The gym TV

If you want to listen to Sky News while you're hammering out 5k on the treadmill, the gym TV could let you listen in on your own headphones, while others listen to the music channels.

## Apple goes it alone

**When it comes to hearing aids, Apple has ploughed a different furrow. Its Made for iPhone standard allowed deaf people to connect their electronic ears to the phones. But Apple is dragging its heels over Auracast Bluetooth.**

**In February, it announced that the AirPods Pro 2 will have a free software update to enable the headphones to become hearing aids. A five-minute test generates an adjustable hearing profile. It's a cheap way of boosting hearing – after all, £230 is nothing compared to the £5,000 quality hearing aids can cost, but the brilliant white earpieces stand out far more than the aids that sit behind people's ears. Battery life is also a concern, as the six-hour charge means they won't last a working day, and it locks people into Apple's ecosystem, the opposite of what Auracast aims to do.**

**Sumbul Desai, Apple's vice-president of health, said: "We believe that technology can help people live healthier lives, and we're delighted to bring the hearing aid feature to the UK."**

hearing aids. Usually tied to the manufacturer's ecosystem, they can cost hundreds of pounds and work for only one person. Auracast-compatible televisions remove the need for a streamer, will work with headphones and hearing devices, and allow multiple people to tune in. And there's no need for yet another wire hanging out of the back of the TV.

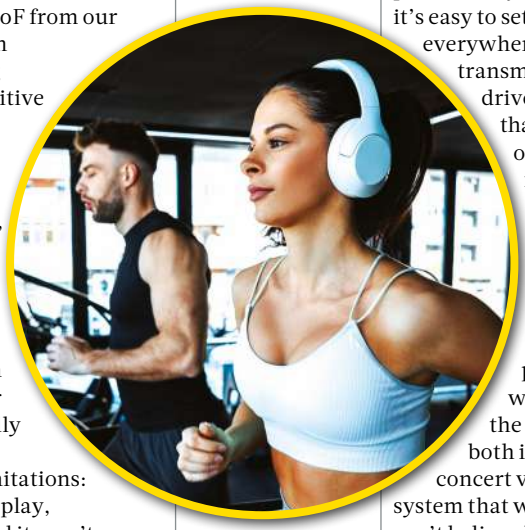
Among those adding Auracast to their ranges are LG and Hisense, while Amazon's latest Fire TVs will connect to hearing aids. The Amazon televisions can send sound to two sources simultaneously, and with separate volume controls. They don't only benefit deaf people – the ability to easily send TV audio to headphones could be a godsend for those working from home, too.

Samsung has already added the standard to its Neo QLED 8K and Micro LED TV ranges, but there has been ambiguity over which models have Auracast. Forums feature irate customers who were advised their purchases were Auracast-ready, only to find they weren't. Retailers have a role to play, training staff and updating listings to explicitly mention Auracast and Bluetooth codecs.

Samsung told *PC Pro* it was exploring hearing aid compatibility. "We introduced Auracast to our product lineup in 2023 and continue to support this technology in our products," a spokesperson said. "We are proud to share that Auracast capabilities are now available on the 8K QN990F and QN900F from our 2025 range. We remain committed to creating technology that's intuitive and inclusive and are constantly working to develop new and updated features across all our models."

Home transmitters are coming to market, too. The HomeSpot BA210 is one, and it costs around £60 from Amazon US. A wonder gadget, it turns virtually any television into an Auracaster but has limitations: although it's plug and play, the manual is poor, and it won't pair to a device that is a transmitter and receiver, which rules out smartphones. With only one audio input, it can't be part of a chain of devices either, so if you have a wired soundbar it's one or the other. However, it's so successful that a church in the United States uses it to broadcast services.

**ABOVE Sydney Opera House was one of the earliest adopters of the Auracast standard**



**ABOVE You can listen to the TV in the gym on your headphones while you're working out**

## Hear to stay?

Auracast is on the cusp of becoming part of everyday life, especially as it's easy to set up and will soon be everywhere. "The momentum of transmitter-level products will drive more deployment, and that will have its own impact on driving more devices for the individual," said Chuck Sabin.

"The simplicity of how this works is far beyond what's available today from an assisted listening perspective. We're working with a theatre in the Netherlands that has both indoor and outdoor concert venues, and they want a system that works outdoors. They can't believe how simple it is to do."

Simple, clear, and affordable: Auracast is a tech that promises to be transformative. You're going to be hearing a lot more about it in years to come. ●

# Google Docs and Sheets HIDDEN FEATURES

There's more to Google's free online office applications than meets the eye: **Nik Rawlinson** explores the advanced capabilities you might have missed

Google Docs and Sheets are two of the world's most widely used productivity applications. There are two very good reasons for that: they're free, and they're easy to use.

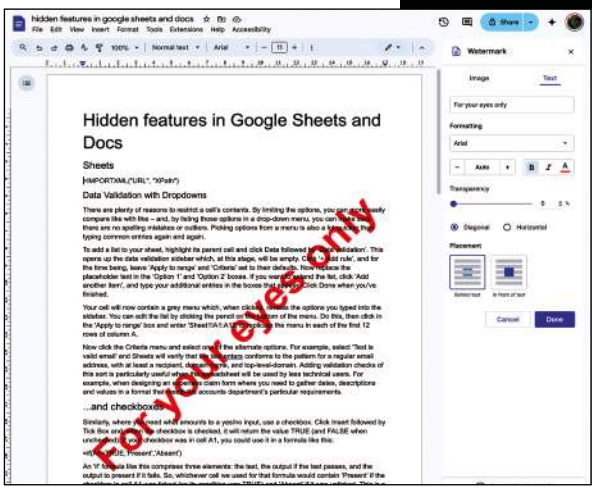
That doesn't mean they're light on features, however. Tucked away in their menus (and in Sheets' library of formulas) are some powerful tools that go far beyond what you're likely to come across in casual use. On these pages we'll reveal the best hidden features in each application: put them to use, and you'll be working faster, with fewer mistakes and better results.

## DOCS Type less with automatic text replacements

You may have noticed that when you type three dots in Google Docs, they get turned into a single ellipsis symbol. Similarly, typing "(c)" or "TM" gives you a copyright symbol or a trademark tag. You can create your own substitutions that work in the same way, to quickly and accurately enter long or tricky words and phrases.

As an example, let's say you want to create a shortcut that inserts a standard legal disclaimer into your documents. To do so, go to Tools | Preferences in any Google Doc and switch to the "Substitutions" tab. You'll see a list of default substitutions; you can edit these, turn them on and off by toggling each one's tick box or remove them completely by clicking the "x" next to their name.

**BELOW**
**Watermarks can sit above or below the text on the page**




**You can create your own substitutions to quickly enter long words and phrases**

To create a new substitution, type your desired shortcut and replacement text into the two empty boxes at the top of the list. For example, we might type "##legal" under "Replace", and enter the desired legal language at the top of the "With" column. Although the text-entry field is small, you can paste hundreds of words in here if you wish. There's no need to use the two hashes, but we've done so to ensure we don't accidentally trigger the replacement when using the word "legal" in the normal way.

Once you click OK, your substitution will be saved, and will then be available across all Docs documents you subsequently open – not just the one you defined it in.

## DOCS Watermark your documents

If you're sending out a draft document for approval, you might want to add a watermark before printing or sharing it, to clearly flag its status as confidential or unfinished.

To do this, click Insert | Watermark then choose either an image- or text-based watermark by clicking the relevant tab at the top of the sidebar. In the screenshot on the left we've added a text-based watermark, and tailored it by adjusting the font weight

and colour. Because the size is set to "Auto", the text shrinks to fit the length of the text string.

The buttons at the bottom of the sidebar let you choose whether to set the watermark behind or in front of your content. If you put it in front, you'll probably want to drag down the Transparency slider, so that your text still shows through – otherwise, any content that appears behind an opaque section of the watermark will be illegible.

## DOCS Use LaTeX-style layout commands

Google Docs provides a reasonable set of formatting features for regular text, but you can also specify more complex mathematical layouts, using a syntax similar to the LaTeX markup language. To create the formula shown in the screenshot below, we selected Insert | Equation, then entered the following text:

**x^4 [Right arrow] = \sqrt \frac 3y^2 [Right arrow][Tab]17**

That series of keystrokes might look daunting when written out in sequence, but it's not hard to understand. It sets out by indicating $x^4$, by preceding the 4 with a caret symbol ("^"). Pressing the right arrow then steps out of the superscript element; after our equals sign we use \sqrt to insert a square root symbol, then use the \frac keyword to start entering a fraction.

We can now enter the top part of the fraction – the numerator – again using a caret to raise 3y by the power of two. Pressing the right arrow again steps us out of superscript text, and we can then press Tab to drop to the lower part of the fraction – the denominator – where we type 17.

Google Docs doesn't precisely follow LaTeX conventions, but if you're already familiar with LaTeX you shouldn't have a problem getting to grips with the equation editor – and anything you learn here can likewise be adapted for use in a pure LaTeX environment.

## DOCS Cite your references

Academic or professional writing requires accurate citations, and Google Docs has built-in support for three common citation conventions: MLA (Modern Language Association of America), Chicago Style (from the Chicago Manual of Style) and APA (American Psychological Association).

To create a citation, type the relevant text in your document, then select Tools | Citations. Select your desired format from the drop-down menu in the sidebar, then click "+ Add citation source". Now select the source type – a website, television programme, book or whatever – and specify how you consumed the work by selecting an option from the "Accessed by" menu.

**If typing is too much of a drag, Docs includes a powerful speech-to-text interpreter**

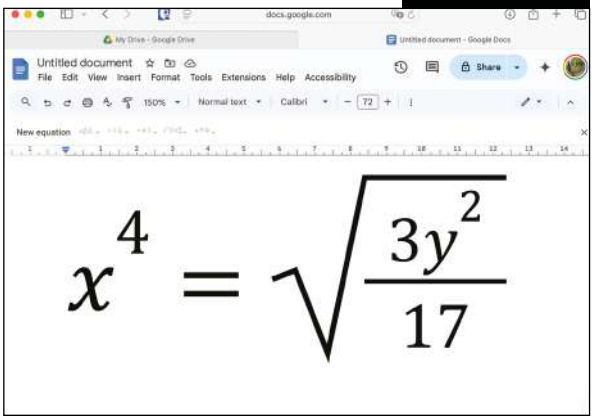
If you're referring to a website, paste the address into the "Search with a URL" box, and click "Search" to have Google Docs automatically retrieve as much information as it can. If there are any missing fields, such as the year in which the page was published, you can click "Continue" and use the form to fill in any additional details, before hitting "Add citation source".

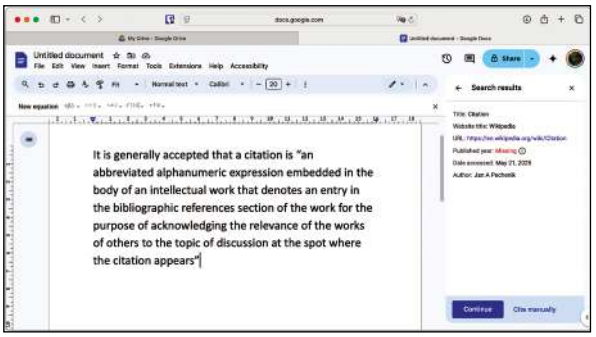
The source will now be added to your list of citations; to insert it into your document, hover over it in the sidebar and click the "Cite" button that appears. When you've finished working on your document, you can position your cursor at the end and click "Insert works cited" (at the bottom of the Citations sidebar) to automatically generate a full list of your reference materials.

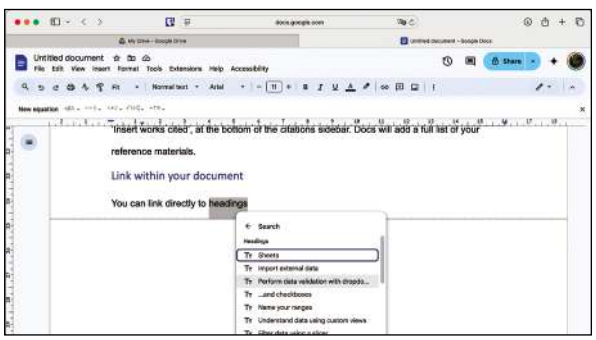
**BELOW** This formula is entirely text-based

**MIDDLE** Google Docs has a built-in citation manager

**BOTTOM** Headings are automatically bookmarked for use as links





It is generally accepted that a citation is "an abbreviated alphanumeric expression embedded in the body of an intellectual work that denotes an entry in the bibliographic references section of the work for the purpose of acknowledging the relevance of the works of others to the topic of discussion at the spot where the citation appears"




## DOCS Link within your document

Sometimes you'll want to refer not to an external source, but to another part of your document. To create a bookmark that the reader can instantly jump to, position the cursor on the line you want to link to, then select Insert | Bookmark.

You can now link to this bookmark from anywhere in your document, by highlighting the link text, pressing Ctrl-K (Cmd-K on a Mac) to create a link, and then clicking "Headings, bookmarks and tabs". This reveals all of the headings used in the document (even if you've not bookmarked them), along with your own bookmarks. Click the one you want to refer to and the highlighted anchor text will be converted to a hyperlink. You (or your reader) can then click the link to jump straight to the destination.

## DOCS Don't type – talk

If typing is too much of a drag, Google Docs includes a powerful speech-to-text interpreter, which you can use to capture quick notes or dictate long passages of text. To bring up the dictation control, select Tools | Voice typing, or press Ctrl+Shift+S. A little window will now open showing a microphone icon; click on this to start dictating, and click again to turn it off, or say "stop listening".

As well as inserting text with your voice, you can punctuate and divide up your sentences using intuitive commands and phrases such as "full stop", "colon" or "new paragraph". You can also browse and edit your work, using a wide range of natural-language commands such as "select all", "scroll down", "go to end of line" or "delete word". If you want to explore the full range of voice commands Google Docs understands, just say "voice commands list".

## SHEETS Import external data

You can always copy and paste data into a Google Sheet, but it's often better practice to import it directly from the source. If, for example, you want to work with the results of the first semi-final of this year's Eurovision Song Contest, you can bring the table directly from Wikipedia into Sheets by entering this formula into a cell:

**=IMPORTHTML("https://en.wikipedia.org/wiki/Eurovision_Song_Contest_2025", "table", 7)**

The IMPORTHTML command can fetch tabular data from almost any page, parsing the variables within the brackets to find the data source you're after – in this case, "table" number "7" at the given web address. Although you only type the formula into one cell, Google Sheets will spread the data into as many neighbouring cells as necessary to render the complete table.

The first time you import data this way, Sheets will warn you that about receiving data from an external source. Click "Allow access" if you're happy to proceed. Note too that some elements on Wikipedia, such as discussion boxes and summaries, don't immediately look like tables, so it's not always obvious which number you want: you might need to experiment until you find the right data.

A similar command – IMPORTRANGE – can be used to import data from other Google Sheets. Assuming you've entered the above formula into cell A1 of your Sheet, the list of countries will have been imported into cells B2 to B17 (B1 is the heading). We can now refer to that list in a second spreadsheet, using the URL of the first sheet as follows:

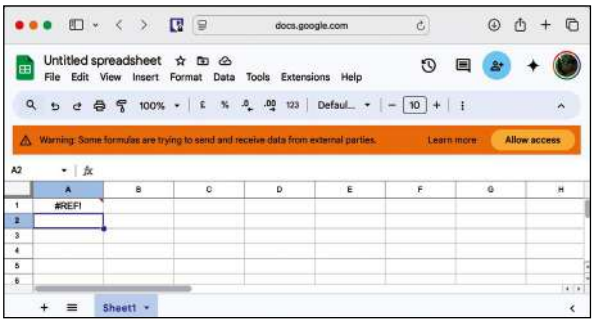
**=IMPORTRANGE("URL", "Sheet1!B2:B17")**

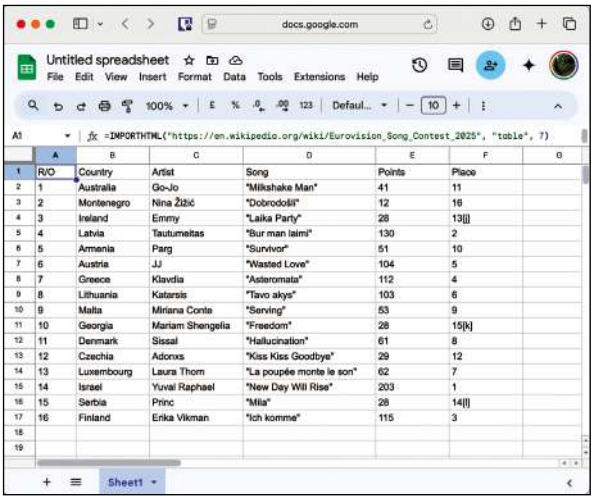
If you enter this formula in cell A1 of your new spreadsheet, the list of countries will run from A1 to A16, even though it appeared in B2 to B17 of the original spreadsheet. Any change you make to the data in the original spreadsheet will be automatically updated in the spreadsheet that refers to it, which saves you the job of manually keeping your sheets in sync.

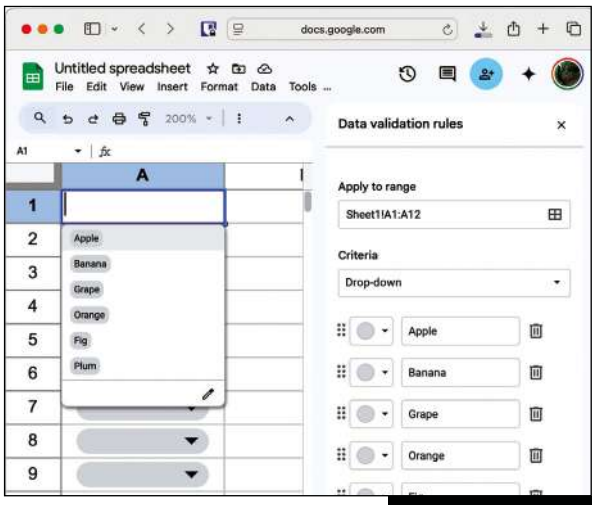
## SHEETS Work quickly and accurately with drop-down lists

Using drop-down lists can help you enter data more quickly, and without the risk of typos. To add a drop-down list to your sheet, highlight a cell and select Data | Data validation. This opens up the Data validation sidebar, which will at this stage be empty. Click "+ Add rule", and for the time being leave "Apply to range" and "Criteria" set to their defaults.

Now replace the placeholder text in the "Option 1" and "Option 2"





docs.google.com
Untitled spreadsheet
File Edit View Insert Format Data Tools Extensions Help
=IMPORTHTML("https://en.wikipedia.org/wiki/Eurovision_Song_Contest_2025", "table", 7)
R/O Country Artist Song Points Place
1 Australia Go-Jo "Milkshake Man" 41 11
2 Montenegro Nina Žižić "Dobrodošli" 12 16
3 Ireland Emmy "Laika Party" 28 13[j]
4 Latvia Tautumeitas "Bur man laimi" 130 2
5 Armenia Parg "Survivor" 51 10
6 Austria JJ "Wasted Love" 104 5
7 Greece Klavdia "Asteromata" 112 4
8 Lithuania Katarsis "Tavo akys" 103 6
9 Malta Miriana Conte "Serving" 53 9
10 Georgia Mariam Shengelia "Freedom" 28 15[k]
11 Denmark Sissal "Hallucination" 61 8
12 Czechia Adonxs "Kiss Kiss Goodbye" 29 12
13 Luxembourg Laura Thorn "La poupée monte le son" 62 7
14 Israel Yuval Raphael "New Day Will Rise" 203 1
15 Serbia Princ "Mila" 28 14[l]
16 Finland Erika Vikman "Ich komme" 115 3
Sheet1




**TOP/MIDDLE** You'll need to authorise fetching data from the web, such as this data from Wikipedia

**ABOVE** Grey menus show the options from our rules

boxes with your desired drop-down options; for more options, click "Add another item" as many times as you need, and type additional entries in the boxes that appear. Click "Done" when you've finished.

Your cell will now contain a grey menu which, when clicked, reveals the options you typed into the sidebar. You can edit this list by clicking the pencil on the bottom of the menu. Do this, then click in the "Apply to range:" box and enter "Sheet1!A1:A12" (you don't need the quotes) to reproduce the menu in each of the first 12 rows of column A.

From the Criteria menu in the sidebar you can also apply other types of data validation, such as allowing text entry but requiring that the data conforms to the format of a regular email address or date – useful when the spreadsheet is intended to be shared with non-technical users.

If you need a yes/no input, you can alternatively use a tickbox rather than a drop-down menu. To do this, simply click Insert | Tick box; this box will have the Boolean value TRUE when ticked, or FALSE when unticked. So, for example, if someone's attendance was represented by a tickbox in cell A1, you could write a formula like this:

**=IF(A1,'Present','Absent')**

## SHEETS Name your ranges

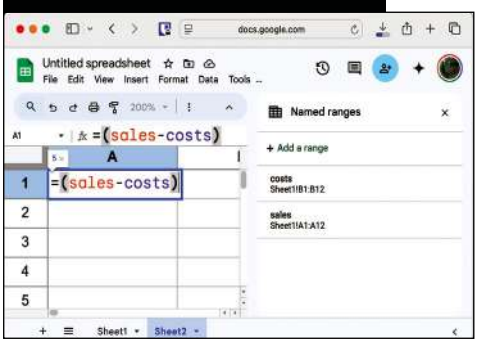
The usual way to refer to a range of cells is with a colon between the first and last cells – so to add all the values in the first 12 rows of column A, you could use:

**=SUM(A1:A12)**

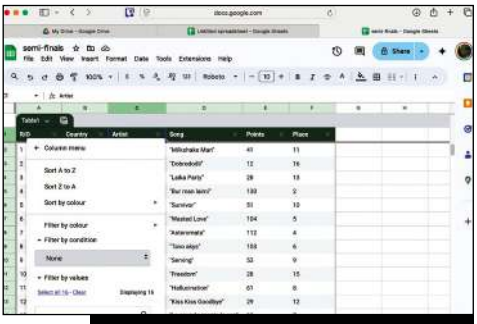
If you're working with several different blocks of data, however, you can make your life a lot easier – and your formulas a lot more readable – by giving names to your ranges. For example, let's assume you have a sheet where the figures in cells A1 to A12 represent income, while cells B1 to B12 are expenses. To name these ranges, click Data | Named ranges, then click "+ Add a range".

Now you just need to select the box that shows "NamedRange1" and replace that text with "sales". The box below shows whatever range of cells you had selected when you clicked to add the range; change this if needs be, so it shows "Sheet1!A1:A12". Click "Done", then

**BELOW** Named ranges can be used in place of column and row references




**Using drop-down lists can help you enter data more quickly, and without the risk of typos**



**ABOVE** Converting data to a table makes it easy to filter and sort

repeat the process for "costs", giving the range "Sheet1!B1:B12".

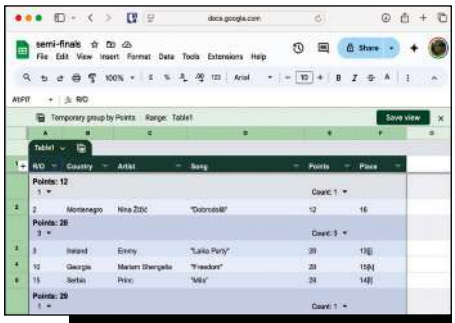
Now you can work with easily understandable expressions, such as:

**=SUM(sales)-SUM(costs)**

The result is same as you would have seen if you'd performed the calculation by manually specifying the ranges. And because the named range specifies the sheet as well as the cells, you can use it in other sheets within the same document.

## SHEETS Understand data with custom views

If you're using Google Sheets you're probably working with tables of data – but it's a good bet that you haven't formally defined them as such. To remedy this, highlight a block of cells,



**ABOVE** Countries with the same score are shown as a group

right-click within the block and select "Convert to Table". Once you've done this, the cells in your top row will become headers, which you can click on to reveal useful sorting, filtering and grouping options.

You can filter the table view by ticking and unticking entries, or filter by conditions – for example, you might choose to hide any cells below or above a certain value, hide empty cells, or only see cells starting or ending with particular characters.

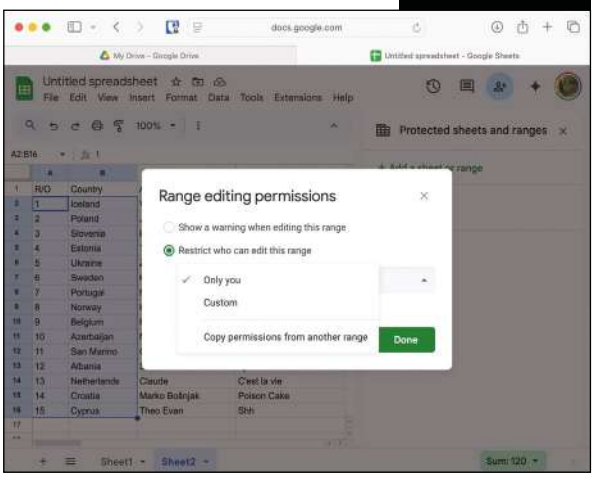
**RIGHT** Sparklines are tiny charts that live within a cell

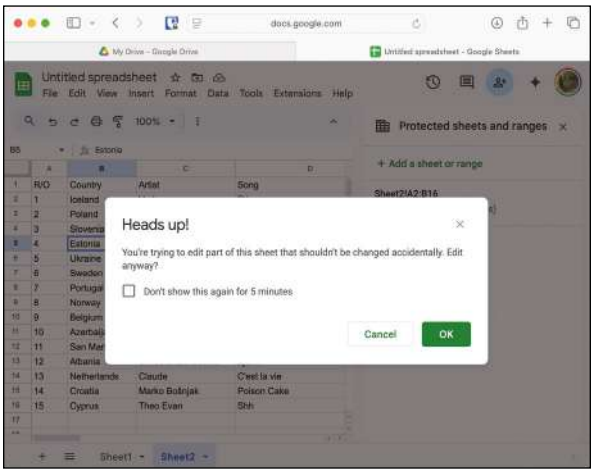
**A sparkline is a line graph that gives you an at-a-glance overview of a data series**

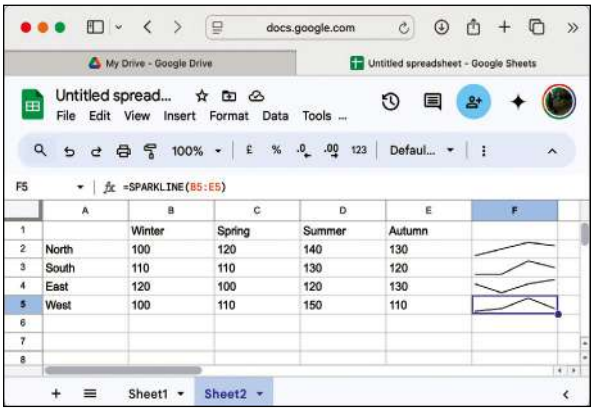
You can also reorder your view of the table to group items together. To do this, click the calculator icon beside the table name, hover over "Create group by view", then select one of the grouping options shown. Using the Eurovision data we imported above, these would include Artist, Points and Place; clicking

**TOP** Stop other users editing data by protecting it

**MIDDLE** Users are warned if they're about to edit a protected range





Heads up!
You're trying to edit part of this sheet that shouldn't be changed accidentally. Edit anyway?
Don't show this again for 5 minutes
Cancel
OK
Protected sheets and ranges




Points groups the rows so that countries achieving the same score are shown together, as you can see from the screenshot.

This arrangement of our table is only temporary, and if you change the view setting, the grouping will be lost. If you want the ability to easily come back to it later, click "Save view" in the green bar above the table and give it a name. It will now appear on the menu that appears when you click the calculator button beside the table name.

## SHEETS Protect ranges

When collaborating on a spreadsheet, you might want to prevent your colleagues from editing certain cells. To do this, select the range that shouldn't be touched and select Data | Protect sheets and ranges.

Sheets will auto-populate the Range box with your selected cells and drop the cursor into the description box, where you can add an explanatory note. You can restrict editing so that only you, or you and specified collaborators, can make changes; alternatively, you can allow anyone to make changes, but show a warning before those changes are applied.

Sometimes it makes more sense to lock the whole sheet, and only allow editing of certain cell ranges. To do this, click the Sheet tab in the side bar, then tick "Except certain cells". You can then define the ranges in which shared users can make changes without authorisation.

## SHEETS Get an instant overview with sparklines

A sparkline is a neat little line graph that appears inside a single cell, giving you an at-a-glance overview of a data series. In the screenshot below, we've used sparklines to summarise seasonal sales fluctuations for an unnamed product in four regions. For the western region we did this by placing the cursor in cell F5 and using the formula:

**=SPARKLINE(B5:E5)**

Doing the same for the other regions gives us an instant comparison of performance nationwide, with sparklines that all update automatically as the data changes. We could also hide columns B to E to conceal the numeric variables, and make the sparklines the focus.

# INSTANT EXPERT

# DISPLAYS

## Confounded by contrast ratios? Doubtful about Delta E? Darien Graham-Smith takes a close look at the specs and capabilities that allow the best screens to shine

**When you're buying a new phone, tablet or laptop, the quality of the screen is a big consideration. And naturally the same applies if you're buying a new monitor for a desktop PC.**

**The trouble is, there are many factors that contribute to the overall quality of a screen, and when you're reading an online specification sheet – or even a review in *PC Pro* – it can be hard to visualise what they all really mean and how they tie together. Here's our guide to all the different display features and measurements, and what to look for. Next month, alongside our annual group test of monitors, we'll dig into the various different display technologies commonly used in modern screens, explore how they work and set out the strengths and weaknesses of each type.**

### 1 Brightness

One of the most immediately obvious qualities of a display, brightness is usually measured in candelas per square metre, or cd/m² – one candela being roughly equivalent to the light put out by a single candle. Display brightness is also sometimes quoted in "nits", a term derived from the Latin "nitere" (to shine); the conversion is pretty easy to do in your head, as one nit is equal to 1cd/m².

The brightness figures we cite in our reviews represents the measured luminance when the screen is completely white, with the brightness setting turned up to maximum. A brightness of 250cd/m² is a usable minimum for a desktop monitor, but a display capable of putting out 500cd/m² or higher will be a lot easier to read in bright sunlight; the latest high-end mobile devices claim a peak brightness well in excess of 1,000cd/m². Screens that support HDR may go even higher than their measured "maximum" when showing HDR media, as we'll discuss below.

By the way, don't confuse candelas with lumens: lumens are a measure of total light output in all directions, making them useful for devices such as smart bulbs. Candelas measure the intensity of light in a particular direction, which is what we're interested in for a computer display.

### 2 Contrast

Contrast represents the difference in brightness between black pixels and white pixels. A bright screen with low contrast will look washed out, while one with middling brightness and excellent contrast might look very bold and clear, as long as you're viewing it in a dark environment, where the highlights aren't overwhelmed by ambient light. The ideal, of course, is to combine high brightness with high contrast.

Contrast is expressed as a ratio, with a ratio of 2:1 meaning the brightest areas are twice as bright as the darkest ones. That would be a terrible score, though – a decent baseline is more like 1,000:1, but higher is always better and many phones and laptops get closer to 2,000:1. In the case of OLED screens, where black pixels aren't illuminated at all, the contrast ratio is effectively infinite.

### 3 Glossy or matte finish

While brightness and contrast have a lot to do with the manufacturing of the LCD panel, another major factor is the screen covering. Glossy displays reflect ambient light directly away from the display, boosting the effective contrast and causing blacks to look inky and solid. The trade-off is that if a bright light is shining on the screen, the reflection will glare directly into your eye.

A matte finish, by contrast, diffuses the incoming light. This means no distracting reflections, but it inescapably lightens the overall appearance of the screen. The result is a much lower-contrast image, with shadows and colours appearing comparatively dull.

It's up to you whether you prioritise contrast or a reflection-free display, and it doesn't have to be a binary decision, as some screens are glossier than others. If possible, this is something that's worth inspecting for yourself, as the effect might not be picked up in a lab test. That's because a colorimeter will typically block off external light to measure the native black level of the display, giving a misleading impression of what the contrast looks like in real-world use.

### 4 HDR

A screen that supports high dynamic range (HDR) content can process and display an extended range of shades between black and white, or between dark and light colour tones. Most videos and games

that support HDR use the HDR10 format, which employs 10-bit encoding to record four times as much tonal detail as standard dynamic range (SDR) content.

This extra information isn't just used for smoothing out colour gradients; it allows the display to "stretch out" the tonal range to make full use of the device's capabilities. Blacks appear as dark as the panel can possibly make them, while the whites are blazingly bright, for a visual experience that goes well beyond what you'd normally see in apps and web pages.

This is usually achieved by aggressively dimming or completely turning off the backlight in dark areas, while driving it up well beyond the usual viewing brightness in the highlights. The result can be dazzling: when we test mobile screens, the maximum spot brightness measured while displaying HDR content is sometimes twice as bright as the highest screen setting available for regular usage.

## 5 Colour coverage and volume

Colour coverage is a measurement of a display's ability to produce a defined range of colours. The most common reference range is the sRGB space ("standard red, green and blue"); this represents a full rainbow of visible colours, from rich primary hues to subtle midtones, and is the assumed default for digital images. If a display can only reproduce 60% of the sRGB spectrum, photos and graphics might look rather drab; one with 95% sRGB coverage may not be able to produce the very deepest greens or blues, but will probably look absolutely fine.

For the most striking visuals, many video- and photo-editing apps allow you to work in larger colour spaces, and desktop monitors sometimes have switchable colour modes to match the gamut you're targeting. The Adobe RGB gamut includes rich green and cyan tones that go beyond the deepest colours available in sRGB; these can add depth and life to nature photography when viewed on a compatible display. Cinematic productions often use the DCI-P3 space, which includes warmer, deeper reds, greens and yellows; consumer screens don't usually cover this whole space, but video professionals will want one that gets as close to 100% DCI-P3 coverage as possible.

A related measurement is colour volume. This tells you how big the range of producible colours is, relative to a given colour gamut, but it doesn't necessarily mean that the colours are all within that gamut. For example, if a display has exceptional red and green performance but poor blues, it might have an sRGB colour volume of 110%, but coverage of only 90% of that space.

## 6 Refresh rate

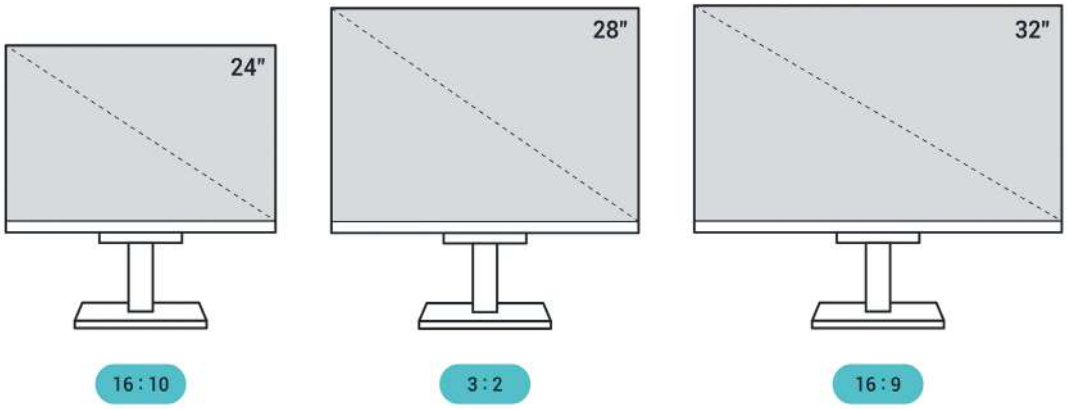
Since films are shot and shown at 24 frames per second (fps), you might wonder why there's any need for your display to refresh any faster than that. However, when you're sitting close up to a computer display, dragging windows around or scrolling up and down a web page can look distinctly choppy at 24 or 30fps – which is why, for several decades, computer displays have defaulted to a faster refresh rate of 60Hz.

**ABOVE Glossy displays have deeper blacks but reflect light**

Today, high-end screens often go up to 120Hz, to ensure that all on-screen motion is perfectly fluid. The difference between 120 and 60Hz is subtle but discernible, especially on mobile devices that are often viewed at short range.

Some desktop monitors also go up to 120Hz, or even higher. The intention here isn't just to do with smoothness: it's also to ensure that the screen can keep up with fast-moving action games, allowing the player to see what's going on, and react, as quickly as possible. A sixtieth of a second might sound like a negligible benefit, but in competitive gaming even the tiniest fraction of a second can give you an edge over your opponent.

The catch is that gaming at 120fps or above requires graphics hardware that's actually capable of updating the screen that often: you're not getting the best from a 120Hz monitor if the computer is only rendering 30 frames per second. And while the latest Nvidia graphics cards can make games play smoothly at very high frame rates by using AI to interpolate frames, this introduces latency, meaning that what you see on the screen could actually be one or two frames behind the action.




## 7 Dynamic refresh rates

Computer displays have traditionally operated at a fixed frequency, but we're increasingly seeing phones and tablets with dynamic refresh rates. When you're scrolling up and down, the display updates at an impeccable 120fps, but as soon as you take your finger away, the display quietly drops down to a much lower refresh rate – sometimes as low as 1Hz – to save power when there's no movement on the screen.

Gaming monitors implement dynamic refresh rates in a different way, using a technology known as FreeSync (developed by AMD but now fully supported by Nvidia). This provides a smooth visual experience by rendering frames at whatever rate the source can provide them: if the game is putting out 120 frames per second, that's what you'll see, but when the GPU has to slow down, the frame rate will seamlessly dial down, with no tearing or stuttering.

## 8 Colour accuracy (Delta E)

Being able to reproduce a wide range of colours is important, but it's little use if they're not the right ones. Colour accuracy is measured using a colorimeter and expressed in terms of Delta E, which means the difference in perception (*Empfindung* in German) between the desired colour and what the monitor actually produces.

Delta E is a scale from 0 to 100, where 100 means that the colour displayed is the exact opposite of the one desired, and a score of 50 means that the colour is precisely midway between the intended tone and its opposite. A screen with a Delta E of 10 would be usable, but might suffer from a conspicuous colour cast or shift.

Early LCD screens often had shockingly poor accuracy, but nowadays almost every device we see has an average Delta E of below 2, which is absolutely fine for everyday viewing of photos and videos. You can often improve matters further by calibrating the screen with a colorimeter, which tells the video driver how to adjust its output to match the desired tones.

The ideal is a Delta E of less than 1, which means the colours displayed on the screen are close enough to the correct tones that the difference is imperceptible to the human eye – ideal for professional photo or video work.

## 9 Aspect ratio

The standard resolutions mentioned above all have a standard aspect ratio of 16:9, meaning they're 1.78 times as wide as they are tall. This shape was standardised way back in 1984, having been selected as a convenient compromise between the contemporary 4:3 TV format and the wider screens used in cinemas. Although 4:3 media is now pretty much dead, the 16:9 shape has become universal for home media devices.

That doesn't apply to computer screens, however. Whether you're updating spreadsheets on a laptop or playing games on a phone or tablet (rotated into landscape orientation), many people prefer to have a bit more vertical space. Accordingly, device screens often use a taller 16:10 ratio, with typical resolutions of 1,920 x 1,200 or 2,560 x 1,600.

Conversely, gamers may prefer a wider screen that gives them a broader view of what's going on all around them. Wide shapes can also be convenient for those who want to work with two or more windows side by side. Displays using the stretched 21:9 aspect ratio typically offer resolutions of 2,560 x 1,080 or 3,440 x 1,440. There are even a few specialist screens with an ultrawide 32:9 shape – equivalent to two widescreen displays sitting next to each other.

**ABOVE An aspect ratio of 3:2 or 16:10 gives you more vertical space than conventional 16:9**

**BELOW Calibrating a display with a colorimeter can help tune colour accuracy**

## 10 Response time

Response time is a measurement of how long it takes for an individual pixel to change colour, and while this isn't the same as the refresh rate, it has a similar significance. A 120Hz refresh rate isn't much use if each pixel takes a sixtieth of a second to switch to its intended state.

The most commonly used measurement of response time is grey-to-grey (GTG), which tells you how long the pixel takes to change from its original colour to the destination one (it's called "grey" because the LEDs themselves are all white, and use filters to produce colour). If the GTG time is slow, you'll see motion blur, even if the refresh rate is high. Ideally you want a response time that's less than the time it takes to draw one frame, so for a 120Hz display that's 8.3 milliseconds.

Another measurement you might see is "moving picture response time" (MPRT), which represents the shortest time a pixel can be illuminated for. Again, you want this to be less than one frame: if the MPRT is longer, you may see "ghosting", as pixels remain illuminated after they're supposed to have shut off.

## 11 Resolution

The native resolution of a screen represents the number of physical pixels it has, horizontally and vertically. The general baseline resolution for video displays is 1,920 x 1,080, also known as Full HD or 1080p. The "p" stands for "progressive scan", meaning that every horizontal row of pixels is redrawn every frame; this is to distinguish it from the older 1080i ("interlaced") standard, which drew odd- and even-numbered rows in alternation, meaning it took two frames to fully redraw the screen. Pretty much

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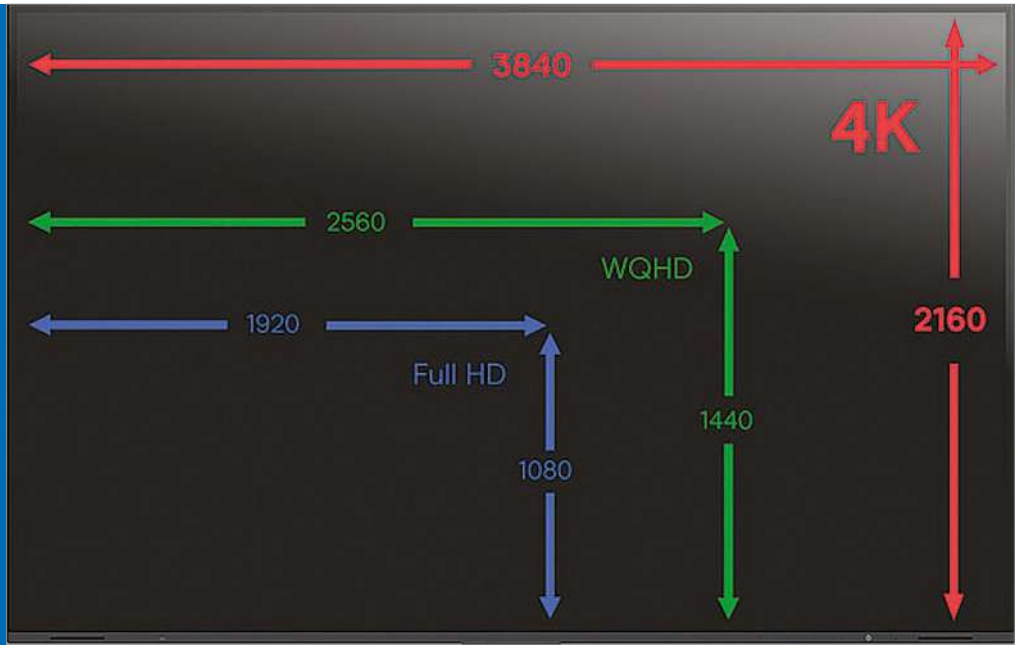



nothing uses interlaced scanning today, but the convention lives on.

Other common resolutions are 2,560 x 1,440 – sometimes referred to as 1440p – and 3,840 x 2,160, commonly called 4K as an approximation of the horizontal resolution. 4K is also known as Ultra HD (or just UHD), reflecting the fact that it has twice as many pixels as Full HD in both the horizontal and vertical planes; 8K UHD screens double the dimensions again, to 7,860 x 4,320, but these are rare outside of cinematic setups.

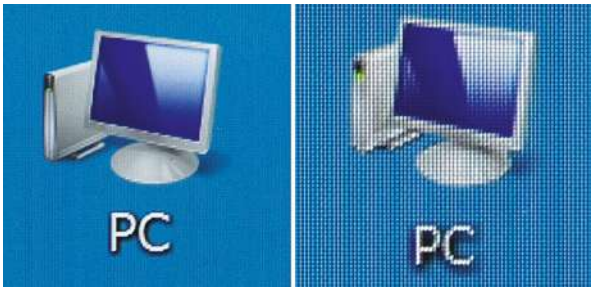
There's a variety of other abbreviations floating around out there for other resolutions, such as UWFHD or WUXGA, but these aren't standardised. It's best (and clearest) to look at the actual pixel dimensions rather than relying on such obscure terms.

## 12 Size

For historical reasons, the size of a display is usually cited in inches, and is measured across the diagonal rather than along the top or the sides.

This means the measurement can be deceptive when comparing screens of different shapes. A 13in laptop screen with a 16:9 ratio will measure 29cm x 16.2cm, giving you a screen area of 466cm², while a 16:10 screen of the same nominal size will measure 28cm x 17.5cm. That means you get a little less width, but a greater total area of 490cm².

The difference naturally becomes more pronounced with more extreme screen shapes. A 30in desktop display with a 21:9 ratio will be 29.6cm tall, while a 30in 16:10 screen would be a full 10cm taller, with a 25% larger screen area. That's well worth bearing in mind if you're comparing displays of different formats.




**TOP** **A Full HD resolution is the bare minimum you can expect today**

**ABOVE** **Low pixel density (right) results in blocky text and images**

## 13 Pixel density

The size and resolution of a display together determine its pixel density. This is measured in ppi (pixels per inch), or sometimes dpi (dots per inch) – although that term really refers to physical print, not digital pixels. The size of an individual pixel on a particular display is referred to as its dot pitch, and is measured in millimetres.

A low pixel density makes things look blocky, with a particularly noticeable impact on the quality and readability of text, while a high pixel density allows for smoother curves and sharper edges. If the individual pixels are so small that they can't be individually resolved by the human eye, the resolution is functionally perfect.

What that means in practice depends on how far away the screen is from your eyes. On smartphones, which are often held less than 30cm from your face, the ideal is a resolution above 300ppi; Apple's Retina-branded iPhone screens range from 326 to 460ppi across different models. For laptops, anything above 220ppi is generally indistinguishable from perfection. A 28in monitor with a standard 4K resolution will offer a pixel density of 157ppi – high enough to appear perfectly sharp at a typical viewing distance.

While high-ppi displays can look beautifully clean and clear, it takes a certain amount of graphical processing power to generate and draw all those pixels. Gamers often choose big screens with a middling pixel density, or manually set their display scaling to a relatively low resolution such as 1080p. This ensures that their graphics hardware can keep up with a high frame rate, rather than getting a sharper but jerkier experience.

## 14 Viewing angle

Viewing angles are important for televisions, where a family might all want to watch the screen from different places in the room. But personal devices are designed to be primarily viewed head-on, and manufacturers don't always prioritise viewing angles. This could be an issue if, for example, you want to use a tablet or laptop to share media with others, as anyone watching at an angle might see washed-out colours or poor contrast. Since manufacturers don't normally give you much useful information about viewing angles, this is another thing that's good to check out for yourself before buying.

Viewing angles can also be significant when it comes to very wide screens. If you're sitting right in front of the centre of a large, wide display, you may find that when you turn your head to see the sides of the screen, the quality is affected by your quite acute viewing angle. For this reason some wide displays are curved, so that all parts of the display face directly towards you – as long as you're sitting in the right place. ●

## BLUE LIGHT

**There's some evidence to suggest that exposure to light with a strong blue component tells your brain that it's daytime, regardless of whether it comes from direct sunlight or the glow of an LCD display. So if you're using a mobile phone in bed or playing games late into the evening, the light from your screen can mess with your sleep patterns.**

**Some displays include a blue light filter that gives the screen a warmer cast, which you can enable either manually or to a preset schedule. Different manufacturers use different branding for this feature: Asus calls it "Eye Care", Dell calls it "Comfort View Plus" and Apple refers to it as "Night Shift".**

**If you're using Windows 11 you don't need to worry about whether your display has a built-in blue light filter, as there's one built into the OS. The feature is called "Night Light", and you'll find it in the Settings app, under "Display".**

# Reviews

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# Chillblast Poseidon

## Ryzen 9 RTX 5090 Water Cooled Gaming PC

The most spectacular PC we've ever tested and, while it's totally over the top, we can't help but love it

PC PRO RECOMMENDED

**SCORE** ★★★★★

**PRICE** £5,833 (£7,000 inc VAT)
**from** chillblast.com

Back in the day, we used to invite manufacturers to send in their wackiest, most expensive designs as part of our Ultimate PCs group tests. Go wild, we said. Create a work of art. Well, Chillblast – a Warrington-based manufacturer that has appeared in *PC Pro* on 44 previous occasions – listened to the echoes of that call and created something truly spectacular.

The aptly named Poseidon is simply magnificent to behold, a whirl of transparent pipes and futuristic curves that combine function with form. The function being simple: keep the components cool so that you can extract the maximum performance from them for the longest possible period. It does so with barely a murmur and only the occasional gurgle, but I daresay that if viewed from afar you might spot a heat haze from its top after hours of gaming: pop a cafetière on it and your coffee will stay lovely and warm.

### Weight and wait

I also strongly recommend that two of you lift this PC into place. I tend to be of the "oh, it'll be fine" persuasion, take a deep breath and heave even the heaviest of PCs onto my desk. This one made me pause and grab my son for help: it wasn't so much the weight, around 20kg, but the density packed into the compact body. And the Poseidon really is compact considering everything inside; smaller than many regular PCs I test.

Perhaps another reason for my caution was that with all this glass, and the knowledge of the precision engineering that's gone into it, I didn't want to risk any damage or disturbance. Chillblast told me that each unit is "built meticulously by hand, and pressure-tested by our most experienced builders". On top of all the usual quality checking, it's then put through a soak/leak test.

**ABOVE** The stunning Poseidon PC is truly a sight to behold

**BELOW** The PC comes with the fastest gaming CPU/GPU combo you can get

It reckons each build takes two to three days, so you can see why the £7,000 price adds up to far more than the components. This also goes some way to explaining the two- to three-week lead time that Chillblast quotes, although it told me some of this extra time is to give it leeway during builds. Hopefully it will land with you sooner.

Your investment also includes a five-year warranty, with the first three years covering parts and labour. Here, those three years also cover the cost of an annual refresh. This involves flushing and refilling the system along with a clean and polish – much like a car service. Opt for the Water Cooled Care+ package, a £400 extra, and Chillblast won't charge you for courier costs, and it will

also change the coolant so you can choose a new colour. Plus it will fully strip down everything and replace any parts (such as pipework) that show signs of deterioration.

## Grand designs

If you think you have the skills to recreate this PC yourself, the first thing you'll need is a Montech King 95 Pro chassis, which features 4mm tempered glass that definitely contributes to this system's weight. You'll then need to invest in the water-cooling system, which is where costs start to rack up as the Poseidon includes a distro-plate – a necessary feature when sharing the water between the GPU and CPU. That's quite aside from all the piping, the skills required and extra hardware that Chillblast uses to flush the coolant and remove any particulates that will almost certainly appear once you switch it on.

This is the perfect chassis for such a build, as it means you can stop and admire the metal joins, the Steampunk-esque angles and the sheer playfulness of it. Calling it a work of art is going a step too far, but if you buy this machine then you need to put it somewhere where it can be admired. Think of it as an aquarium for techies.

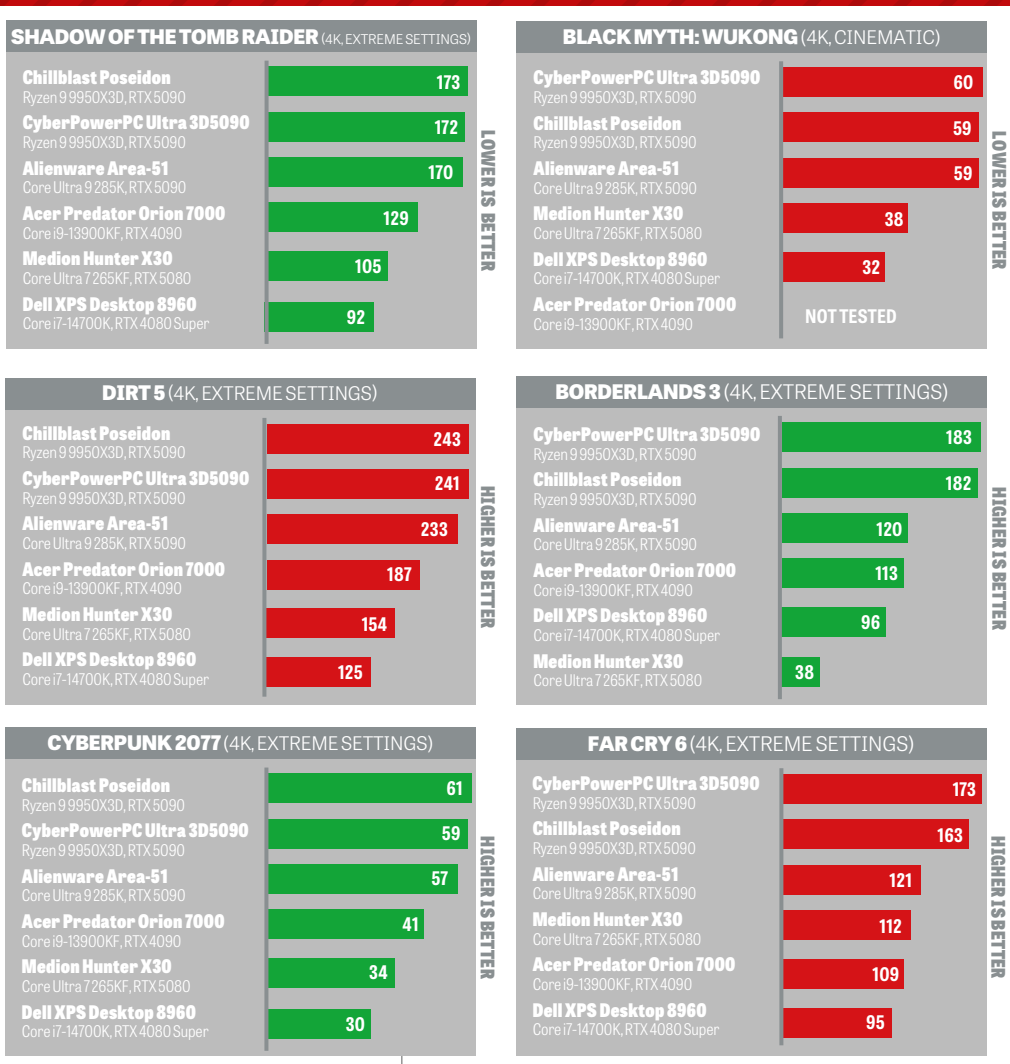
## Speed bumps

If you're hoping that all this amazing liquid-cooling technology will also take you to unparalleled heights of performance then I have bad news. Yes, the Chillblast Poseidon is fast, but no faster than the CyberPowerPC Ultra 3D5090 (*see issue 370, p58*) I tested last month. At the time I thought that was expensive at £4,000, but now it starts to look like a bargain.

Both PCs happen to share the same core components: AMD's Ryzen 9 9950X3D processor and RTX 5090 graphics, though Chillblast doubles the RAM to 64GB. Essentially that means you're buying the world's fastest gaming processor along with the world's fastest consumer graphics card, so it should be no surprise at all that the two systems duke it out at the top of table in all six of our gaming tests.

Does it matter that the CyberPowerPC is 1fps faster in *Black Myth: Wukong* and *Borderlands 3*? Not a jot: that's within the margin of error, in the same way that the Poseidon is 1-2fps faster in *Shadow of the Tomb Raider*, *Dirt 5* and *Cyberpunk 2077*. The only significant difference came in *Far Cry 6*, a notoriously CPU-bound game, where the CyberPowerPC's 8fps advantage was also reflected in the single-core result in Geekbench 6: 3,428 versus 3,312.

**BELOW Tempered glass allows you to admire the precision engineering within**




## Gaming monster

Frankly, I think these differences are irrelevant. Whatever task you want to do on this PC, it will tear through it, and in the vast majority of the cases that means gaming. The main thing to take away from the graphs on this page are that the Chillblast Poseidon will give you over 170fps at 4K in four of the toughest games around at the ridiculously extreme settings we put them through. Tweak a setting, activate DLSS, and your 240Hz gaming monitor might finally be fully exploited.

Also remember that our *Cyberpunk 2077* test is designed to torture even the best GPUs. When I switched to the far tamer RT Extreme preset, the 4K average jumped to 131fps. Activating 3x Frame Generation pushed that up to 303fps. In short, whatever game you want to play, at whatever resolution, the Poseidon has you covered. As does the CyberPowerPC Ultra 3D5090.

## Storage king

As you can imagine, this isn't a PC designed for end-user upgrades. A single PCIe slot sits empty at the bottom, but it's perilously close to the fans – of which there are many, with three at the bottom, three at the top and one at the rear. There are two empty DIMM sockets if 64GB simply isn't enough, while the Asus ROG Strix X870-F Gaming WiFi motherboard's four empty M.2 sockets sit neatly under heatsinks. Most are easily accessible, too.

Chillblast provides a single 4TB Kingston Fury Renegade Gen 4 SSD, which is the only surprise here: three PCIe Gen 5 SSDs are supported along with two Gen 4. Still, 7,340MB/sec reads and 6,920MB/sec writes are about as fast as you're going to see from a Gen 4 drive, so there's no skimping on quality.

You can also add two 3.5in hard drives via a hatch at the rear of the chassis: undo the thumbscrew (although I needed the help of a screwdriver) and you have access. There are also mounting pads for two 2.5in SSDs, this time accessible if you remove the right-hand panel. Again, a single thumbscrew is all you need to wrestle with.

## All aboard

It's also worth spending a moment to admire the Asus ROG Strix motherboard, which comes packed with useful features and options. Many of these feature everyone's friend, AI, which you can let loose on overclocking, cooling and networking if you so wish. The board also looks stylish, adding yet further to the Poseidon's aesthetic appeal.

**ABOVE** **Most of the ports are at the rear of the PC, so could be tricky to access**

On the practical side, you'll find 13 USB ports on the backplate, two of which are of the USB-C 4 variety. Wired networking hits 5GbE to go with the integrated Wi-Fi 7 and Bluetooth 5.4. And along with a line out and mic in, you'll find an S/PDIF connector. It's quite crowded back there. As this is such a heavy chassis, so not one you can quickly swivel for easier access, you'll probably find yourself mainly sticking to the single USB-C and pair of USB-A ports on the front of the chassis.

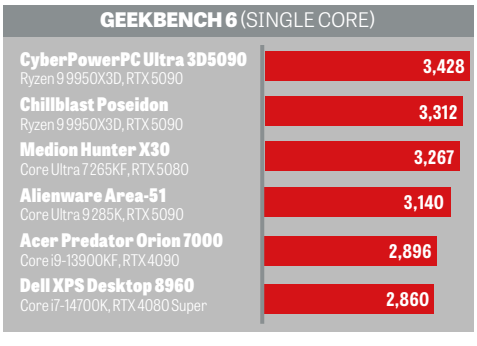
Chillblast again sticks with the Asus ROG Strix family for the PSU, a monstrous 1,200W unit that's tucked out of sight but still looks stylish if you remove the right-hand panel. This brings us to one of the more contentious points of this PC: it demands 130W of power even at idle, rising to 967W at its peak. The CyberPowerPC is a fraction more conservative, at 108W and 957W.

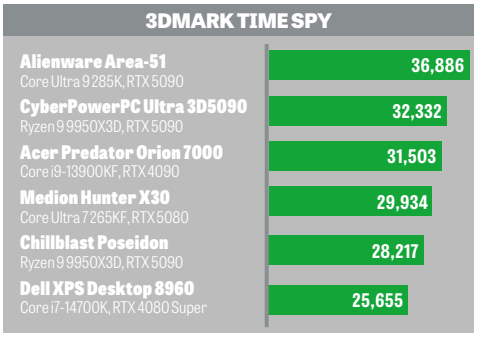
## Vanity buy

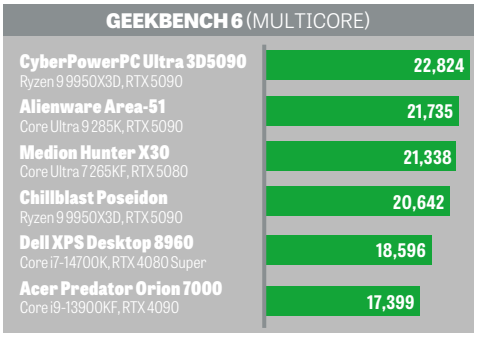
Should you buy the Chillblast Poseidon? The rational answer is surely no: you can buy the exact same amount of power, even a little more, if you choose the CyberPowerPC Ultra 3D5090 for £4,000. And bear in mind that if you want to keep the Poseidon looking as good on day 1,000 as it does on day one then you'll need to keep investing. I don't think there's any point buying this system and not also buying the £400 Care+ package – and even then you need to consider sending it back to Chillblast in year four, year five, year six. The CyberPowerPC, on the other hand, will just keep chugging along.

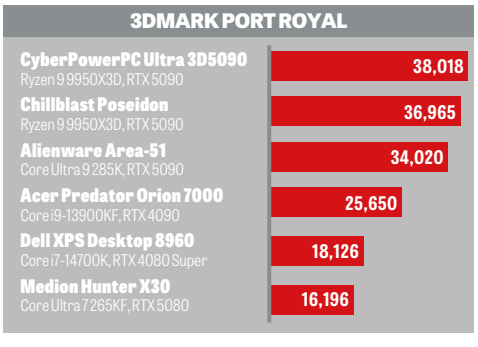
**"Here, you're buying a PC to admire as much as you use it, in much the same way you might a high-fashion watch or a luxury car"**

But that's the thing. Here, you're buying a PC to admire, in much the same way you might a high-fashion watch or a luxury car. If the Chillblast Poseidon brings a smile to your lips each time you look at it, and sparks conversations with visitors, then it has added value way beyond a set of benchmark results or fluid 4K gaming. Whether that's worth an extra £3,000, I'll leave entirely to you. **TIM DANTON**




### SPECIFICATIONS

16-core/32-thread AMD Ryzen 9 9950X3D processor • Asus ROG Strix X870-F Gaming WiFi motherboard • 64GB Kingston Fury Beast RGB DDR5-6000 RAM • 32GB Nvidia GeForce RTX 5090 graphics • custom water-cooled loop system • 4TB Kingston Fury Renegade PCIe Gen 4 SSD • Montech King 95 Pro chassis • 1,200W Asus ROG Strix Platinum 80 Plus Platinum PSU • Windows 11 Home • 300 x 442 x 475mm (WDH) • 5yr warranty (3yr C&R plus 2yr RTB labour-only) • power: 130W idle, 967W peak

# PCSpecialist Frostbyte Elite

## A solid foundation for Nvidia's RTX 5060 graphics, this is a stylish PC that can be dispatched within a day

**SCORE** ★★★★☆

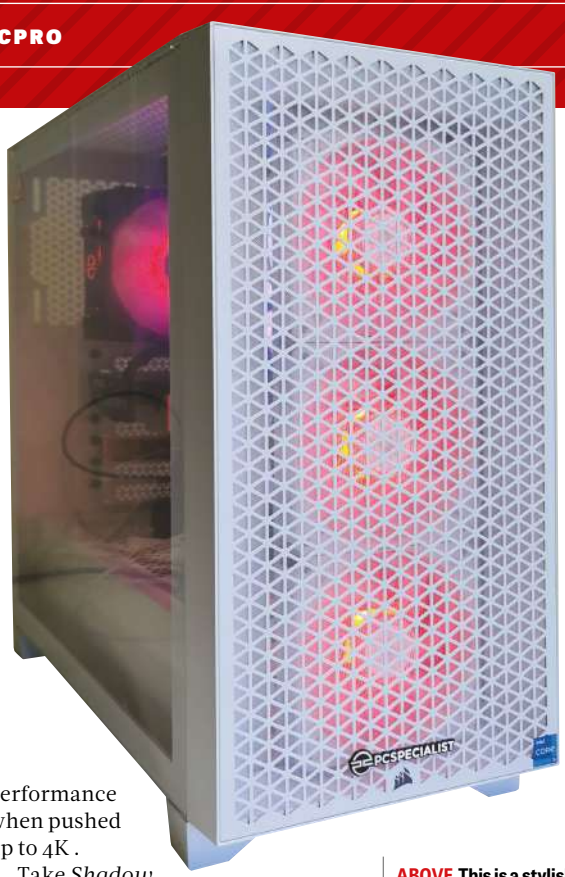
**PRICE** £833 (£999 inc VAT)
**from** pcspecialist.co.uk

It's hard to think of a greater contrast to the bombastic Chillblast Poseidon than this demure PC. It's a mid-tower unit, but being based on Corsair's all-white 3000D chassis it's so discreet that it could appear in a Habitat catalogue and not look out of place. Providing you switch off the RGB lighting on its three front-facing fans, at least.

The Frostbyte – a brief round of applause to PCSpecialist for this PC's name – is also discreet in operation. During working hours you'll barely notice the whisper of the fans if this PC is sitting next to you on a desk, and even when playing games it never roars.

That's partly due to the efficiency of the RTX 5060 card, making its debut here. This sits at the bottom of the RTX 50 series pecking order, with 3,840 CUDA cores, a 2,497MHz boost clock and 448GB/sec memory bandwidth – almost twice that of the RTX 4060. The 5060 Ti (*see issue 370, p62*) has the same bandwidth but typically comes with 16GB rather than 8GB of RAM, while also packing 4,608 CUDA cores and a 2,572MHz boost clock.

So to the big question, how fast can it go? With the support of Intel's mid-range Core i5-14400F processor and 32GB of RAM, a 3DMark Time Spy score of 13,010 correctly set my expectations as 100+ fps in less demanding games at 1080p, but flaky performance when pushed up to 4K.



Take *Shadow of the Tomb Raider*, *Dirt 5* and *Borderlands 3*, which fall into the "less demanding" category. In *Tomb Raider* at Highest settings, with no DLSS, the PCSpecialist averaged 130fps at 1080p, 83fps at 1440p and 38fps at 4K. In *Dirt 5* and Ultra High settings, 120fps, 96fps and 60fps. *Borderlands 3* and Badass settings: 112fps, 84fps and 45fps. *Far Cry 6* is a little tougher and returned 95fps, 86fps and 50fps with Ultra settings.

Our *Cyberpunk 2077* test is harder still, as it's based on RT Ultra settings but with no DLSS. This brought frozen tears to the Frostbyte Elite's eyes, with averages of 51fps at 1080p, 28fps at 1440p and 2fps (really) at 4K. Switching to the RT Ultra default, which includes DLSS, those scores jumped to 73fps, 54pfs and 31fps.

Move away from games and the Frostbyte's results look pedestrian. The Core i5-14400F includes six P-cores and four E-cores, but it's testament to the power now found in mobile chips that it was outscored in Geekbench 6 by a couple of the laptops in this month's Labs (*see p76*). Its single-core result of 2,426 is particularly mediocre, and there were times during our testing when I missed the raw power of a faster CPU.

Despite being a mid-range motherboard, the Asus Prime B760-Plus includes a USB-C port rated at 20Gbits/sec, 2.5Gb Ethernet and three M.2 sockets. The M.2 sockets all support PCIe Gen 4, none of them Gen 5, and the supplied 1TB Crucial P3 drive produced solid read/write results of 5,044MB/sec and 3,682MB/sec in CrystalDiskMark 8.

There's plenty of elbow room inside the chassis for upgraders, but few actual options. The only usable PCIe slot is filled with an Intel Wi-Fi 6E card; there is another PCIe slot, but it's right beneath the GPU's fans. Two DIMM slots also sit vacant, and that's it for upgrades via the motherboard. Slipping off the right-hand side of the chassis – which is easy thanks to two captive thumbscrews – reveals two caddies for 3.5in drives and mounting positions for a pair of 2.5in SSDs.

**ABOVE** This is a stylish PC that looks as cool as its name suggests

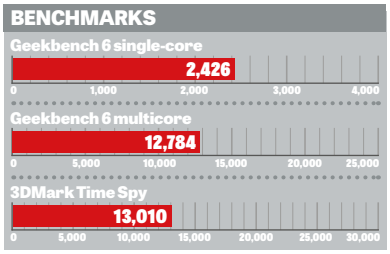
**"Any PC would struggle to shine in the shadow cast by the Chillblast Poseidon, but let's not forget that this machine costs £999"**

**LEFT** It's easy to get inside the chassis

**BELOW** There's lots of room inside the case, but few actual options

Any PC would struggle to shine in the shadow cast by the Chillblast Poseidon, but let's not forget that the Frostbyte costs £999. Plus it's part of PCSpecialist's flotilla of "next day" PCs, so if it's in stock it will be dispatched by courier the following day. It's also backed with a three-year warranty and the reassurance of PCSpecialist's strong reputation for customer support, so if this is your budget then it's a solid, stylish choice. **TIM DANTON**

### BENCHMARKS




### SPECIFICATIONS

10-core (6 P-cores, 4 E-cores) Intel Core i5-14400F processor • Asus Prime B760-Plus motherboard • 32GB Corsair Vengeance DDR5-5200 RAM • 8GB Nvidia GeForce RTX 5060 graphics • PCS FrostFlow 100 aRGB v3 air cooler • 1TB Crucial P3 Plus M.2 PCIe Gen 4 SSD • Intel Wi-Fi 6E AX210 card • Corsair 3000D RGB chassis • 650W Corsair CX PSU • Windows 11 Home • 230 x 462 x 466mm (WDH) • 3yr warranty (6 month C&R, 1yr RTB parts & labour, 2yr labour only) • power: 60W idle, 288W peak

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SCAN

# Microsoft Surface Laptop, 13-inch

Not the fastest, but the stunning design and extreme portability add up to fantastic value for undemanding users

PC PRO RECOMMENDED

**SCORE** ★★★★☆

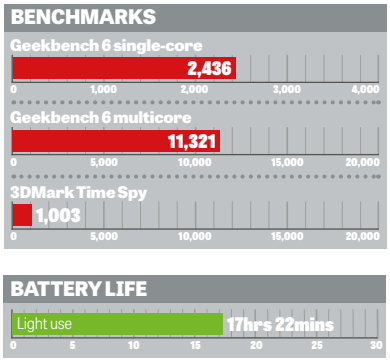
**PRICE** As reviewed, £866 (£999 inc VAT)
**from** microsoft.com

I have been begging Apple to release a purple MacBook for years, so when I found out that the Microsoft Surface Laptop 13-inch would come in Violet – pastel purple to you and me – I elbowed my way to the front of the review queue. I'm not disappointed: this laptop is simply stunning.

When finished in boring, default Platinum, the Surface Laptop 13-inch is as close to a MacBook Air for Windows as you're going to find, but the Violet and Ocean colourways lift it above all rivals. The machined aluminium finish of the chassis works brilliantly in these pastel hues, all set off by the darker, matte colour of the keycaps and trackpad.

This is also a brilliantly portable device despite not being as slim and light as its obvious Windows rival, the Asus Zenbook A14 (*see p84*). That weighs a featherweight 980g and measures 13.4mm tall, so on paper it may seem that the Surface Laptop 13-inch is decidedly porky at 15.6mm thick and 1.3kg. However, I found carrying the Surface Laptop around was hassle-free: it slipped into all my bags and was still compact enough that I could use it on a long-haul flight (which I genuinely did) without any issues.

And battery life is stellar. It lasted for more than 17 hours in our standard battery tests, outlasting the Apple MacBook Air 13in (*see issue 368, p54*) by a good two hours, so on-the-go charging almost becomes a non-issue. If you do need to bring a USB-C charger, it only requires 45W of power so shouldn't take up much space in your bag. You'll need to pay Microsoft a further £50 if you want its Surface USB-C Wall Charger.




**ABOVE** **The Surface Laptop is a compact, great-looking device with stellar battery life**

## Arm wrestling

What holds the Microsoft Surface Laptop 13-inch back from being the knockout MacBook Air competitor I hoped it would be is the 8-core Qualcomm Snapdragon X Plus chip. I have nothing against Qualcomm's silicon: I was genuinely impressed by the performance of the Snapdragon X Elite processor, as found in the 13.8in Surface Laptop, 7th Edition (*see issue 360, p50*), despite the compatibility challenges that Windows on Arm is still working through. But that was a far more powerful chip than what's inside this laptop.

**"Battery life is stellar. It lasted for over 17 hours in our standard battery tests, outlasting the MacBook Air 13in by a good two hours"**

That can be seen in its benchmark scores, although if you focus on the CPU alone then things don't look too bad. In Geekbench 6, the Surface Laptop 13-inch returned 2,436 and 11,321 in the single-core and multicore sections respectively, notably faster than the 2,136 and 10,475 of the Zenbook A14.

However, the Surface Laptop 7 returned 2,809/14,426, and it's

similarly overpowered by the M4-powered MacBook Air – available for £999 with 256GB of storage, but stepping up to 512GB costs another £200 – which scored 3,741 in the single-core section and 14,849 in the multicore tests.

It's a similar story for 3DMark Wild Life Extreme, with the MacBook romping away with a 7,757 return while the Surface Laptop 7 scored 6,499, leaving the Surface Laptop 13-inch and Zenbook A14 trailing behind with 3,243 and the Zenbook 3,222 respectively.

While benchmarks on their own don't matter, as we've observed about all Copilot+ PCs powered by the 8-core Snapdragon X Plus it does make a palpable difference in use. We tend not to see a problem with Arm-native apps such as Chrome and Office, but once you move to x86 apps that need translation through Microsoft's Prism software layer there can be a notable slowdown.

I wouldn't want anyone to think the 8-core chip is awful. It's perfectly good for general computing tasks such as streaming and office productivity, but if you need to do anything other than write up reports or use web-based cloud software then you may not be best pleased by Microsoft's chip choice.

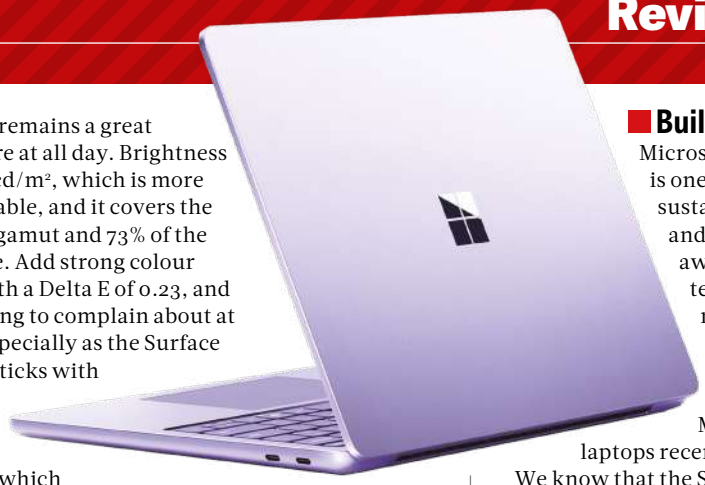
## Real world usage

The flip side to this is that if you're looking for a new laptop to do office work, perhaps finally write that sci-fi novel at the local coffee shop, then the Surface Laptop will do the job just as well as more expensive options. And, in case I haven't mentioned this enough, none will look as good as the Violet edition.

Plus, the key switches are quiet and have good travel and responsiveness, so you won't annoy your companions. Everything is well spaced, so you won't feel cramped despite the laptop's slimmer-than-average width. The trackpad is likewise responsive and smooth, making navigation and clicking around the 13in diagonal a breeze.

The display is a step down in size from the 13.8in Surface Laptop 7 (which remains on sale) with its 2,304 x 1,536 resolution. That translates into 201 pixels per inch (ppi). The Surface Laptop's 13-inch panel packs 1,920 x 1,280 pixels for 178ppi, but perhaps the most obvious difference between this panel and its sibling is a 60Hz refresh rate rather than 120Hz. Those who abuse their laptops should also note that the cheaper model only features "Strengthened glass" rather than Corning Gorilla Glass 5.

So there is a step down in specification and quality, but don't despair: this remains a great screen to stare at all day. Brightness peaks at 387cd/m², which is more than respectable, and it covers the whole sRGB gamut and 73% of the DCI-P3 space. Add strong colour accuracy, with a Delta E of 0.23, and there's nothing to complain about at this price. Especially as the Surface Pro 13-inch sticks with Microsoft's tried and tested 3:2 aspect ratio, which somehow makes the panel appear bigger than it really is.



ABOVE **Ports are limited to two USB-C, one USB-A and a headphone jack**

## Bits and bobs

It's tougher to defend the port selection, which is limited to two USB-C 3.2 Gen 2 ports, a USB-A Gen 3.2 Gen 1 port and a 3.5mm jack for a headset. That feels a little lightweight: it would be nice to see USB-C 4 ports in there, perhaps even an HDMI connector. At least Microsoft doesn't sacrifice the wireless capabilities, with both Wi-Fi 7 and Bluetooth 5.4 inside.

The webcam, meanwhile, is a 1080p Surface Studio Camera that produces crisp results but doesn't support Windows Hello authentication. Nor does it have a physical privacy shutter, which in 2025 should be mandatory. Instead, your Windows Hello logins come courtesy of a fingerprint sensor built into the power button.

Naturally, this is a Copilot+ PC with all that entails. We cover the latest developments in more detail over the page and in the Labs (*see p85*), but there there's a mix of plus points – including, finally, the arrival of Recall – and questionable inclusions. But the one thing that Qualcomm never cuts down is the NPU in its chips, so this is just as powerful as any other Surface device.

BELOW **The keyboard and trackpad are well spaced and responsive**

## Built to last?

Microsoft claims this is one of its most sustainable laptops, and while we await an iFixit teardown it's notable that the organisation has been kind about Microsoft's laptops recently.

We know that the SSD is removable, while skilled technicians should be able to fix problems with the screen, battery, ports, motherboard, keyboard, fan, trackpad and speakers. Pretty comprehensive, so long as parts are made readily available. As ever with Surface devices, the warranty only lasts for a year, so take a look in the Surface app for upgrade options or extend at the time of purchase: it costs £69 for three years of cover.

**"Had the Surface Laptop 13-inch shipped with an Intel Lunar Lake chip, this would be an entirely different review"**

Had the Microsoft Surface Laptop 13-inch shipped with an Intel Lunar Lake chip rather than the underpowered 8-core Qualcomm Snapdragon X Plus, this would be an entirely different review: I'd be giving this laptop six out of five stars, because in just about every other way than its performance and minor compatibility issues, this is the best laptop I've ever put my hands on.

Aesthetically, it's a big upgrade over the Surface Laptop 7, with a lightweight and sleek design that still packs in a high-quality 3:2 display with plenty of space. Its keyboard and trackpad are a dream to use, too.

But it's not six out of five: it's four and a scraped Recommended award. Before you buy, take a good read through our Labs on affordable laptops this month from p76. There are highly attractive alternatives in there for a similar price. And bear in mind that while the 13in Surface Laptop starts at £899, that's for the 256GB version and is only available in Platinum. If you want 512GB, you'll need to pay £999. At which point you should, as I may have mentioned, choose the Violet finish. **JOHN LOEFFLER**

### SPECIFICATIONS

8-core Qualcomm Snapdragon X Plus SoC • Qualcomm Adreno X1-45 graphics • 16GB LPDDR5X-7467 RAM • 13in, 60Hz IPS touchscreen, 1,920 x 1,080 resolution • 512GB M.2 PCIe Gen 4 SSD • Wi-Fi 7 • Bluetooth 5.4 • 1080p webcam • 2 x USB-C 3.2 Gen 2 • USB-A 3.2 Gen 1 • 3.5mm combo jack • 66Wh battery • Windows 11 Home • 286 x 214 x 15.6mm (WDH) • 1.3kg • 1yr C&R warranty

# Microsoft Surface Pro, 12-inch

The value-focused 12in form factor is new and welcome, but it's best suited to less demanding users

**SCORE** ★★★☆☆

**PRICE** Tablet only/256GB, £666 (£799 inc VAT) from microsoft.com

Once upon a time, Microsoft's Surface devices acted as showcases for the latest Windows features. They championed new form factors, such as magnetic keyboards that snapped into place on the Surface Pro. But times change, with Microsoft slimming down the number of models and its ambition.

The affordable Surface Go range won't be updated, the company told me, with Microsoft instead adding a more affordable 12in Surface Pro – as tested here – to sit alongside the existing 13in offerings. So don't think of the 12in Surface Pro as an upgrade to what was previously called the Surface Pro 11 (*see issue 360, p52*) and is now listed as the "Surface Pro, 13-inch". It's actually a downgrade in terms of speed and screen size.

Wondering whether Microsoft could have made its branding any more confusing? You're not alone.

## Small thinking

If you've seen a Surface Pro device, you'll know what to expect with the 12in Surface Pro. It looks like a normal tablet, although the thick bezels look outdated compared to rivals (even the older Surface Pro 11 – sorry, Surface Pro, 13-inch – has thinner bezels on two sides of the screen).

As with previous models, Microsoft embosses a Windows logo on the rear, and the bottom half can be pulled out to make a kickstand. At the centre of the bottom side, a magnetic port sits ready for the optional Surface Pro 12in Keyboard. If you have an existing Surface Keyboard or Type Cover it won't fit due to the new size.

There are, however, subtle and mostly welcome changes introduced to the design of the 12in Surface Pro. The proprietary Surface Connect port has been ditched; instead you charge the tablet via one of the two USB-C ports. While Microsoft's motivation for this change is mainly to comply with the EU directive that all new electronic devices must support USB-C charging, I welcome it.

Another plus is simply that this tablet is smaller. The 12in Surface Pro is notably more compact with dimensions of 274 x 190 x 7.8mm compared to 287 x 209 x 9.3mm for its sibling, with the weight dropping from 890g to 686g. Enough that you will notice the difference.

Aside from size, there are a couple of other factors that separate the 12in Surface Pro from its stablemates. One is an indent on its rear, which is where you magnetically attach the optional Surface Slim Pen stylus (£120 inc VAT). I was impressed with how secure it felt when in place – I certainly didn't worry that the stylus would drop off the tablet – and how it wirelessly charges when attached. Despite the indent, though, attaching the Slim Pen means the Surface Pro won't sit flush when placed on a table.

**ABOVE** The 12in Surface Pro is more compact than previous models

## Screen sacrifice

Then we come to the screen sacrifices Microsoft has made to reach a lower price than the Surface Pro 11. For starters, there's no OLED option here, so you're stuck with IPS technology, while the refresh rate is capped at 90Hz rather than the 120Hz of the 13in offerings. It also has a lower resolution of 2,196 x 1,464 to the Pro 11's 2,880 x 1,920, and that translates into a lower pixel density: 220 pixels per inch (ppi) versus 267ppi. In practice, I noticed that images don't look as sharp.

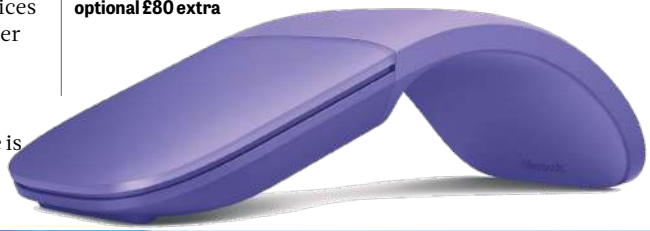
It's still a pleasant screen in use, as we've come to expect from Surface laptops. It's tuned to the sRGB colour space, covering almost all of that gamut compared to around 70% for DCI-P3, and colour accuracy is strong. Brightness peaks at a shade lower than the 400cd/m² that Microsoft claims, but when inside you won't have any challenge seeing what's on the screen.

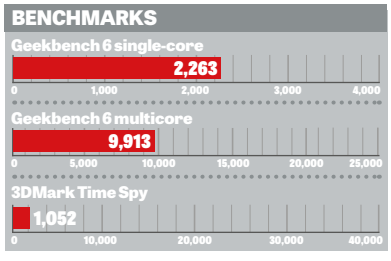
**"Some photos I thought I'd taken hadn't actually been saved, so avoid using the 12in Surface Pro to capture once-in-a-lifetime events"**

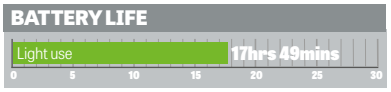
You won't be admiring pictures taken on the Ultra HD rear camera, with noticeable noise in darker conditions. The Camera app also became unresponsive while taking photos, which meant I had to wait several seconds to adjust the focus. Some photos I thought I'd taken hadn't actually been saved, so avoid using the 12in Surface Pro to capture once-in-a-lifetime events.

Don't expect too much from the front-firing speakers or the 1080p webcam, a downgrade on the 1440p model in the Surface Pro 11. But it works reliably enough in a range of lighting conditions for Windows Hello logins, while the usual Copilot+ PC blur and background effects are all on offer thanks to the Qualcomm Snapdragon processor.

**BELOW** The Surface Arc Mouse is an optional £80 extra





## Chipped off the old block

You have a choice of Qualcomm Snapdragon X Plus (10-core) or X Elite (12-core) chips with the 11th edition Surface Pro, but here you only have one option: the 8-core version of the Snapdragon X Plus. It's also clocked a fraction slower than its siblings, but remains a highly capable processor: results of 2,263 in the Geekbench 6 single-core section and 9,913 in the multicore test underline that fact.

And the general performance of the 12in Surface Pro is fine, so long as you stick to lightweight tasks. Although I ran the Arm-native Photoshop without issue, I hit problems when trying to perform too many tasks at once – it became spluttery, with the occasional app crash. Nothing out of the ordinary if you're used to Windows 11, but nor is it the slick iPad experience.

Our usual caveats about gaming on Snapdragon X chips apply, despite improvements. 3DMark Time Spy returned a shade over 1,000, and the only way you're going to reach playable frame rates – even in older games – is to drop the resolution and the settings. This tablet is for the lightest of light gaming.

## Don't click to do

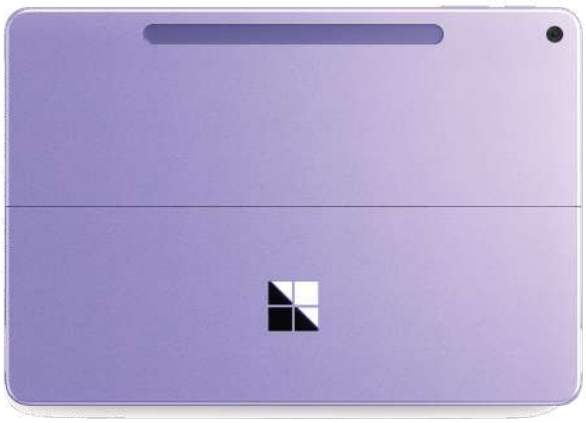
All Snapdragon X chips include the same powerful NPU with support for Copilot+ PC. The latest flagship feature is Click to Do. It's installed as preview software, but feels embarrassingly like an alpha release.

Microsoft pitches Click to Do as a way to do things more quickly in Windows 11 with the help of AI. Hold down the Windows key on the keyboard and the mouse cursor turns into a white dot. Clicking on something (or tapping using the Surface Pro screen) will give the screen a blue tint to show that Click to Do is enabled. If you only have the 12in Surface Pro and no keyboard, you can also activate this by swiping from the right-hand side of the screen.

Click to Do should then offer up quick actions supposedly based on what it sees on your screen, such as opening an image in the Photos app and removing the background. The reality is different. I used Click to Do with my Pictures folder open, clicked on a photo, then selected "Remove background with Paint". Naively, I thought this would open the photo in Paint and remove the background. Instead, it opened the thumbnail preview of the image (which is tiny and pixellated) and removed that image's background. Similarly, when I chose "Blur background with Photos" it opened up the thumbnail in the Photos app. So Click to Do is taking a screenshot of whatever is open, and all you can do is interact with the screenshot, not the actual files.

It almost makes Recall – also in preview – look slick, but I remain unconvinced at how useful it will be. Recall runs in the background taking a stream of screenshots that it OCRs, and you can then scroll back through it to search for things. Or ask natural language commands such as "find that cat presentation".

The trouble is that it's sluggish on the 12in Surface Pro, while the results were mixed. It found screenshots containing search results I'd asked for, but there's a limit to what you can do with them other than open the folder location in Windows Explorer.



**ABOVE** As before, the rear of the device can be pulled out to make a kickstand

**LEFT** The IPS display is decent enough, but images aren't as vivid as on OLED screens

**BELOW** The keyboard and pen bundle will set you back an additional £250

## The plus column

I suggest people largely ignore the AI features; it's the least interesting aspect of the 12in Surface Pro. Instead, I'd focus on the form factor and the power efficiency. For instance, throughout my time with the 12in Surface Pro I appreciated its silence. The Snapdragon is efficient enough that it doesn't need internal fans to keep cool, and that's blissful. Until, it seems, it does overheat and Windows 11 hangs. Maybe a fan would have been a good idea after all.

Another positive is battery life. Microsoft claims up to 16 hours of video playback and that proved an underestimate: I saw 17hrs 49mins in my looped HD video test. Considering the size of this tablet, that's a superb result. You'll certainly be able to bring it on long international flights to work and watch films on, and have plenty of battery left on your arrival.

We now need to talk money. The Platinum version of the 12in Surface Pro comes with 256GB or 512GB of storage (all models include 16GB of memory). The 256GB version costs £799, 512GB ups that to £899. There are also Ocean and Violet versions (the latter looks great), but only in the more expensive 512GB configuration.

A keyboard costs £150 or £250 as a bundle with the Slim Pen, and as with the tablet comes in a choice of three colours. You can also spend £80 on the minimalist Surface Arc Mouse, and you may also want to consider £50 for the 45W USB charger. But let's assume you wisely choose a 512GB model and the keyboard/pen bundle, bringing your total to £1,149.

If you turn to our group test of laptops on p76 you'll see that you can now buy attractive, slim laptops for well under a grand, so this isn't a slam-dunk buy. Where it wins is for lightweight tasks where you simply want a device you can sling into your bag and forget about, especially if you'll use it in tablet mode as much as a laptop. But if you want a slick experience, especially if you tend to push your devices, you'd be better off with the 13in Surface Pro. **MATT HANSON**

**"If you turn to our group test of laptops on p76 you'll see that you can now buy attractive, slim laptops for well under a grand"**

### SPECIFICATIONS

8-core Qualcomm Snapdragon X Plus SoC • Qualcomm Adreno graphics • 16GB LPDDR5X-7467 RAM • 12in 90Hz IPS touchscreen, 2,196 x 1,464 resolution • 256GB/512GB M.2 PCIe Gen 4 SSD • Wi-Fi 7 • Bluetooth 5.4 • 1440p IR webcam • 10MP rear camera • Surface Connect port • Surface Pro Keyboard port • 2 x USB-C 3.2 Gen 2 • 47Wh battery • Windows 11 Home • 274 x 190 x 7.8mm (WDH, tablet only) • 686g (tablet only) • 1yr C&R warranty

# Alienware 16 Area-51

## Strong performer with a unique colour and a ton of ports, but its heavy design binds it to the desk

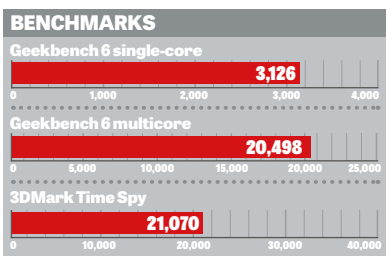
**SCORE** ★★★★☆

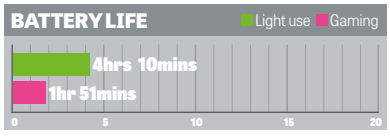
**PRICE** As reviewed, £2,916 (£3,499 inc VAT) from dell.com

The return of Alienware's Area-51 brand brings a futuristic look and what it calls "liquid teal", a dark blue/green that shifts colour depending on the angle at which you look at it. Even the RGB lighting is used to artistic effect, with a blue ring shining through the shelf that juts out the back of the system.

This is where you'll find most of the ports, including three USB-A 3.2 Gen 1, two Thunderbolt 5, HDMI 2.1 and the connector for the 360W power supply. The left side houses only an SD card slot and a 3.5mm jack. Having the ports at the back is good for a clean desk setup but trickier to plug in accessories: the sides are instead dedicated to exhausts for its four-fan system.

That's required to cool the potent pairing of Intel Core Ultra 9 275HX and Nvidia GeForce RTX 5080, and the effort works. In *Shadow of the Tomb Raider* at its toughest settings, the Area-51 ran at 183fps at 1080p and 128fps at the panel's native 2,560 x 1,600, a shade faster even than the Asus ROG Strix Scar 16 (*see issue 370, p70*) with the same CPU and GPU. The Area-51 again edged out its 5080-based peer in *Cyberpunk 2077* at 1080p with 63fps, and proved playable at 2,560 x 1,600 with 37fps.




I used the Area-51 to continue my journey in *Alan Wake 2*, rendering at quality mode using DLSS, along with 3x Frame Gen at the game's highest settings preset. It ran between 136fps and 140fps as I guided Alan through a nightmare set in a television studio, with barely any artefacts, dropping to between 50fps and 60fps with Frame Gen off. But it was sharper.

This was when I missed having an OLED panel, as details in shadow were tough to see, but otherwise this is a great IPS screen thanks to a wide colour gamut (82% of DCI-P3) and 240Hz refresh rate. It's bright, hitting 519cd/m², and the matte finish reduces reflections.

I wasn't as taken by the two 2W tweeters and pair of 2W woofers. They can do the basics, filling a small room with sound and producing clear dialogue, but music lacks bass.

Alienware outfitted our review unit with a low-profile Cherry MX mechanical keyboard, which is worth the £50 upgrade cost. It's louder than most keyboards but I'm not complaining when it feels this good. I only wish that Alienware put macro buttons on the right-hand side rather than volume buttons.

The mechanical touchpad is smaller than I've come to expect on gaming laptops, but it works fine and has RGB lighting for an extra touch of personality. Finally there's the 4K webcam, with accurate colours and great levels of detail plus a sensor for Windows Hello. All nice touches often missing from gaming laptops.

Away from games, the 24-core Intel chip combined with 32GB of RAM proved predictably strong. The inevitable downside is fan noise and battery life: it ran for 4hrs 10mins in our light-use battery test, more than two hours less than the Asus. Not that the Area-51 is a particularly travel-friendly laptop, with its 3.4kg weight heavy even by gaming laptop standards. The PSU adds another 1kg.

If you do travel with this laptop, be wary of sharp objects as they may damage the Gorilla Glass window at the base of the laptop. This reveals a small portion of the motherboard and parts of the fans, which is cool, but I admired it once then never looked at it again. Remove the base entirely and you'll find the battery, RAM and SSD can all be replaced. There are also two empty slots for further M.2 SSDs.

Dell will fill all three with 4TB SSDs in a RAID0 setup in return for £1,500, even if you choose the £2,899 base version with RTX 5070 Ti graphics and 16GB of RAM. £3,499 ups that to an RTX 5080 and 32GB of RAM, while £4,049 upgrades the GPU to an RTX 5090. Every system comes with a Core Ultra 9 275HX CPU, 2TB SSD and 2,560 x 1,600 panel by default.

**ABOVE** The Area-51 is a futuristic-looking laptop with a potent CPU/GPU combo

**LEFT** Most of the ports can be found at the rear, with the sides dedicated to cooling

**"Is it worth the money? It certainly has the looks and the performance, but that comes at the expense of heft and battery life"**

So, is the Alienware 16 Area-51 worth the money? It certainly has the looks and the performance, but that comes at the expense of heft and battery life. Still, if you seek a desktop replacement that's semi-portable and immensely powerful, this 16-incher is for you. **ANDREW E FREEDMAN**

**BELOW** The Cherry MX mechanical keyboard is well worth the upgrade cost

### SPECIFICATIONS

24-core (8 P-cores, 16 E-cores) Intel Core Ultra 9 275HX processor • 16GB Nvidia GeForce RTX 5080 graphics • 32GB DDR5-6400 RAM • 16in non-touch IPS display, 240Hz, 2,560 x 1,600 resolution • 2TB M.2 PCIe Gen 4 SSD • Wi-Fi 7 • Bluetooth 5.4 • 2 x Thunderbolt 5 • 1 x USB-C 3.2 Gen 1 • 2 x USB-A 3.2 Gen 1 • HDMI 2.1 • SD card reader • 3.5mm combo jack • 96Wh battery • Windows 11 Home • 365 x 290 x 21.6-28.5mm (WDH) • 3.4kg • 1yr on-site warranty • order code: aa16250_cto3

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# pro-series

## mid [PRO1]

**£449.99**

| | |
|---|---|
| CPU | AMD RYZEN 5 8500G |
| Core | 6 Cores - 12 Threads |
| Clock | (3.5/5Ghz Turbo) |
| Mob | ASUS TUF A620M-PLUS WIFI |
| RAM | ADATA 16GB DDR5 5600Mhz |
| M.2 | TRANSCEND 1TB M.2 nVME |
| GPU | AMD RADEON Graphics |
| Case | KOLINK Observatory HF MESH |
| O/S | *NO OPERATING SYSTEM* |
| PSU | BUILDER 500W PSU |

## Max [PRO2]

**£979.99**

| | |
|---|---|
| CPU | AMD RYZEN 5 7600X |
| Core | 6 Cores - 12 Threads |
| Clock | (4.7/5.3Ghz Turbo) |
| Mob | ASUS PRIME B650M-A WIFI II |
| RAM | ADATA 32GB DDR5 5600Mhz |
| M.2 | TRANSCEND 1TB M.2 nVME |
| GPU | NVIDIA RTX4060 TI 16GB |
| Case | 1stPlayer D3-A aRGB - Black |
| O/S | *NO OPERATING SYSTEM* |
| PSU | CIT 700W PSU |

## UBER [PRO3]

**£1159.99**

| | |
|---|---|
| CPU | INTEL Core i5 14600K |
| Core | 14 Cores - 20 Threads |
| Clock | (2.6/5.3Ghz Turbo) |
| Mob | ASUS B760M-K |
| RAM | ADATA 32GB DDR5 5600Mhz |
| M.2 | ADATA 2TB S70 Blade M.2 nVME |
| GPU | NVIDIA RTX4060 TI 16GB |
| Case | GAMEMAX F15M MESH |
| O/S | *NO OPERATING SYSTEM* |
| PSU | BEQUIET 850W Gold PSU |

# Aurora RANGE

## i3 Aurora [AUR1]

**£629.99**

| | |
|---|---|
| CPU | INTEL Core i3 14100F |
| Core | 4 Cores - 8 Threads |
| Clock | (3.5/4.7GHz) |
| Mob | ASUS B760M-K |
| RAM | ADATA 16GB DDR5 5600Mhz |
| M.2 | TRANSCEND 1TB M.2 nVME |
| GPU | NVIDIA RTX3050 8GB |
| Case | GAMEMAX Abyss Mini RGB |
| O/S | MICROSOFT Windows 10/11 |
| PSU | CIT 600W Bronze PSU |

## i5 Aurora [AUR2]

**£999.99**

| | |
|---|---|
| CPU | INTEL i5 14400F |
| Core | 10 Cores - 16 Threads |
| Clock | (Turbo 4.7Ghz) |
| Mob | ASUS B760M-K |
| RAM | CORSAIR 32GB DDR5 6000Mhz |
| M.2 | ADATA 2TB M.2 NVMe |
| GPU | NVIDIA RTX4060 8GB |
| Case | CORSAIR iCUE 4000X |
| O/S | MICROSOFT Windows 10/11 |
| PSU | CORSAIR 650W PSU |

## i7 Aurora [AUR3]

**£1599.99**

| | |
|---|---|
| CPU | INTEL Core i7 14700KF |
| Core | 20 Cores - 28 Threads |
| Clock | (3.4/5.6Ghz Turbo) |
| Mob | ASUS PRIME Z790-P WIFI - DDR5 |
| RAM | CORSAIR 32GB DDR5 6000Mhz |
| M.2 | ADATA 1TB S70 Blade M.2 nVME |
| GPU | NVIDIA RTX4070 12GB |
| Case | CORSAIR iCUE 4000X RGB |
| O/S | MICROSOFT Windows 10/11 |
| PSU | CORSAIR 650W Gold PSU |

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# Asus ProArt P16 (2025)

## A brilliant laptop for creatives thanks to its top-end panel, AMD Ryzen CPU and RTX 5070 graphics

PC PRO RECOMMENDED

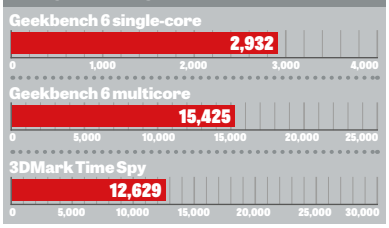
**SCORE** ★★★★★

**PRICE** £2,333 (£2,800 inc VAT)
**from** uk.store.asus.com

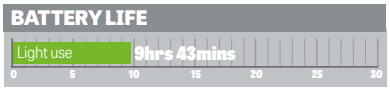
There's always a risk when investing almost three grand in a laptop. Let's say you bought last year's top-end ProArt P16 (*see issue 361, p51*), with its then-new Ryzen AI 9 HX 370 processor and more aged RTX 4070 graphics: was there a chance that this year's model would blow it out of the water with far faster core components?

The answer is yes... and no. AMD is yet to release a successor to the HX 370 and it's once again accompanied by 64GB of DDR5 memory. But the graphics have jumped a generation, with Asus upgrading to Nvidia's RTX 5070 mobile GPU. You can still order the RTX 4070 version for £200 less, but that hardly seems worthwhile.

**BENCHMARKS**




**BATTERY LIFE**




I had hoped that Asus would up the GPU to an RTX 5080 in light of Nvidia's switch to the more efficient Blackwell architecture, but no, you're stuck with the middle ground in terms of GPU power. That hands an advantage to rivals such as the Razer Blade 16 2025 (*see issue 369, p58*), which supports up to RTX 5090 despite a similarly slim chassis.

## Slim design

As with the Blade 16, there is much to admire when it comes to the P16's design. Asus may be famous for its brash gaming laptops, but the ProArt P16 is all about understatement, from its matte black finish to its almost indiscernible "Asus ProArt" logo on the bottom left of the lid. There isn't a flicker of RGB to be seen, to the point where it's actually tricky to spot the black power button above the F12 key.

Despite its slim dimensions, Asus crams in the ports. The proprietary connector for its 200W power supply sits on the left, sensibly towards the back so it doesn't interfere with other ports and cables. Next comes an HDMI 2.1 output, then a USB-C 4 port, USB-A 3.2 Gen 2 port and 3.5mm jack. USB-C and USB-A ports again sit on the right, alongside an SD Express 7 card slot. There's no RJ45 port, but Wi-Fi 7 is present alongside Bluetooth 5.4.

**ABOVE** The ProArt P16 is a robust, well-designed creative powerhouse

**"Asus may be famous for its brash gaming laptops, but the ProArt P16 is all about understatement. There isn't a flicker of RGB to be seen"**

## Workstation speed

Asus supplies the ProArt P16 with Nvidia's Studio drivers, which makes sense for a workstation laptop. In SPECviewperf 2020 its best scores predictably came in the viewsets for 3ds Max, Catia, Creo and SolidWorks, where it returned scores of 116, 74, 104 and 277 respectively. This makes it a solid choice for animation and CAD, matching and even beating the bulkier Lenovo ThinkPad P1 Gen 7 (*see issue 364, p54*) which scored 93, 90, 111 and 223 in those same tests.

The ThinkPad has an RTX 2000 Ada GPU, which is tuned for professional tasks rather than games. A fact that becomes obvious when you look at the two laptops' performance in the Medical and Siemens NX viewsets, with the ThinkPad returning 109 and 383 compared to 39 and 25 for the ProArt.

The ProArt exacts its revenge in gaming tests, as shown by a 12,629 result in 3DMark Time Spy versus 9,321 for the ThinkPad. I saw the same pattern in real games. On the default

**BELOW** The laptop crams plenty of ports into its slim chassis

settings in the games' benchmarks (which are less harsh than the settings we usually use), the Asus returned 162fps in *Shadow of the Tomb Raider* at 1080p Highest compared to 133fps for the Lenovo. In *Cyberpunk 2077* at 1080p Ultra, it was 104fps versus 72fps.

Last year's ProArt P16, with its RTX 4070 GPU, scored 135fps in *Shadow of the Tomb Raider* and 88fps in *Cyberpunk 2077*. It also returned a more modest 11,451 in 3DMark Time Spy. But as we've mentioned before, the RTX 50 series supports Multi Frame Generation, which uses AI to boost frame rates. It doesn't always work well, but can make the difference between smooth and jerky gaming.

## Everyday power

With the same 8-core, 16-thread AMD Ryzen AI 9 HX 370 processor in place as before, this year's model performed almost identically in CPU-focused benchmarks. That means it's stupendously fast in general use, but falls behind Intel's higher-threaded rivals on occasion.

The best news is that battery life remains strong for such a powerful laptop. A 96Wh battery always helps, but if you drop the screen brightness down to under 200cd/m² (around 70% in Windows brightness settings) you should get a solid day's work out of it. To put that into solid numbers, it lasted 9hrs 43mins in our tests compared to 7hrs 22mins for the Razer Blade 16 (albeit with RTX 5090 graphics).

There's more good news if you don't fancy carrying the 470g power brick around with you. Both USB-C ports can be used to charge this laptop, and while they will do so far more slowly than Asus' PSU it should be enough to keep it chugging – it's only if you start pushing the CPU and GPU that you'll see the capacity drop.

## Tone perfect

All this longevity comes despite one of the best screens you'll find on a laptop. Based on OLED technology, it produces a stunning range of colours going 18% beyond the DCI-P3 gamut. That was at its default setting, but if you head into the ProArt Creator Hub you can select from a variety of presets to tune it as you wish: sRGB clamps it to that colour space, likewise DCI-P3. My only request to Asus is that it adds an Adobe RGB preset, especially as it goes to the bother of having this panel Pantone certified. However, you can calibrate the screen yourself with an X-rite i1 Display Pro/Plus calibrator.

This panel's colour accuracy is in effect perfect, too, with an average Delta E of 0.31 and worst score of 0.73. Some might criticise it for a peak brightness of 382cd/m², but indoors I found it comfortable to read even at 150cd/m². Admittedly it doesn't fare well under sunlight, but that's more to do with the panel's reflectivity.

Asus backs up the stupendous visuals with equally magnificent audio: thanks to powerful bass and superb detail, there isn't a single music genre that won't sound great on the P16. Asus also includes a 1080p webcam, but it needs a software update: the compression is so bad that it looks almost cartoon-like. At least it had no problem recognising me for facial logins.

More importantly, the keyboard is a pleasure to use, in part because Asus doesn't include a number pad and that means the deck is centrally placed. I had no problems reaching my usual touch typing speeds, with any typos my own fault rather than Asus'. The only annoyances are a single-height Enter key and half-height cursor keys.

Underneath sits one of the world's biggest touchpads, to the point where it's almost too large. I kept brushing it and moving the cursor when I didn't mean to; perhaps Asus should have dedicated one of the function keys to switching the pad on and off.

The size means room for the Asus Dial, a circular unit built into the top left of the pad. The idea is that you can use it in apps such as Photoshop as you might a real, physical dial, but with your finger moving clockwise or anticlockwise around the "wheel" to adjust settings. It works, and those with dextrous fingers may find it a genuine timesaver, but you can't match real hardware.

## Upgrades and storage

Asus provides a generous 2TB of storage, albeit a Gen 4 SSD rather than Gen 5, so read and write speeds are unexceptional by modern standards at 5,255MB/sec and 4,871MB/sec. Still, that's hardly going to hold you back.

A second M.2 slot lies empty if you ever need more storage, but it's hard to gain access, with 11 Torx screws keeping the metal bottom in place, and not a lot else that can be done once you fight past them. The battery is replaceable, as is the M.2 Wi-Fi card, but the memory is embedded onto the motherboard. Well done to Asus for providing a detailed service manual, but let's hope that it provides the parts (*see Lee Grant's column, p113*).

**ABOVE** **The 16in OLED touchscreen is one of the best displays you'll find on a laptop**

Asus claims the ProArt P16 "exceeds" the MIL-STD 810H military standard, passing tough tests for humidity, sand, dust, altitude, high and low temperature, vibration and shocks. All of which makes you wonder why it doesn't provide a more generous warranty, with a single year of cover. Luckily, MyAsus makes it easy to upgrade, with an extension to three years of basic cover costing £50.

**"This longevity comes despite one of the best screens you'll find on a laptop. Based on OLED technology, it produces a stunning range of colours"**

Other software worth exploring: MuseTree, a local AI service for generating images, and Asus' odd StoryCube software to manage photographs and other media. There's also an AI-based virtual assistant, OMNI, which allows you to upload documents locally and then ask questions about them in natural language.

While I have a couple of criticisms, Asus provides a compelling mobile workstation for a great price. The Razer Blade comes in many more configurations but also costs far more, while the ThinkPad is more professional but also far less portable. If the RTX 5070 is powerful enough to meet your needs, the ProArt P16 (2025) is worth the substantial investment. **TIM DANTON**

**BELOW** **The superb keyboard and huge trackpad are great for productivity tasks**

### SPECIFICATIONS

12-core/24-thread AMD Ryzen AI 9 HX 370 processor • 8GB Nvidia GeForce RTX 5070 graphics • 64GB DDR5-6400 RAM • 16in OLED touchscreen, 120Hz, 2,560 x 1,600 resolution • 2 x 2TB M.2 PCIe Gen 4 SSDs • Wi-Fi 7 • Bluetooth 5.4 • 1 x USB-C 4 • 1 x USB-C 3.2 Gen 2 • 2 x USB-A 3.2 Gen 2 • HDMI 2.1 • SD Express 7 card reader • 3.5mm combo jack • 96Wh battery • Windows 11 Home • 355 x 245 x 14.9-17.3mm (WDH) • 1.9kg • 1yr C&R warranty • part code: H7606WP-RJ088W

# OnePlus Pad 3

## OnePlus continues to lead the way for Android tablets with this 13in beauty, and it's a genuine iPad alternative

**SCORE** ★★★★★

**PRICE** 12GB/256GB, £441 (£529 inc VAT) **from** oneplus.com

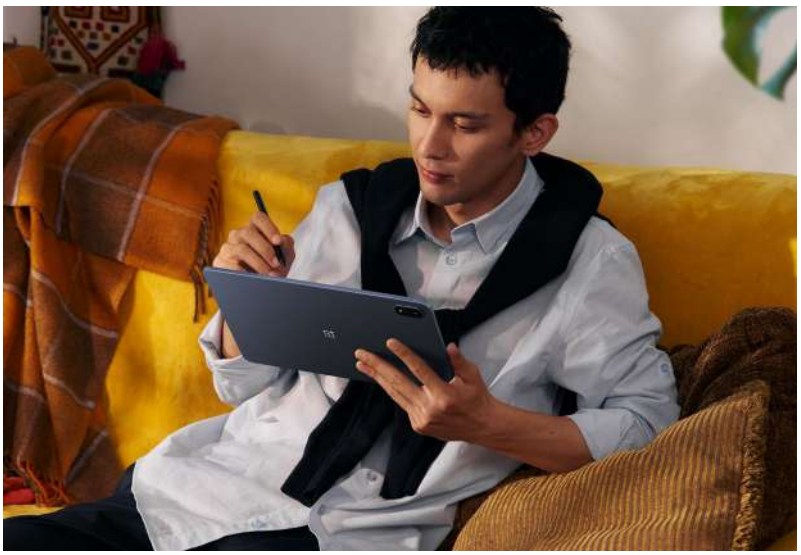
I always hoped the day would come when I'd find an Android tablet I'd be happy to exchange for my iPad – and here it is. I do have a few quibbles with the OnePlus Pad 3, and it can't fully replace an iPad for all people and purposes, but in my view it's absolutely the best balance of price and features you can get in a tablet. It starts at a reasonably affordable £529 inc VAT in its basic form with 12GB RAM and 256GB storage, or £599 for 16GB RAM and 512GB storage.

The design isn't especially eye-catching. The flat edges and pill-shaped camera bump are par for the course, and it's only available in a sombre Storm Blue colour. Still, in terms of usability what matters much more is its size. At 6mm, the Pad 3 is palpably thinner than the OnePlus Pad 2 (*see issue 364, p86*), while the display is more than an inch bigger than its predecessor. These aren't specs for specs' sake: you now have more to work and play, with zero sacrifices – quite the opposite.

However, the OnePlus Pad 3 has equally slim opposition. The new iPad Air (*see issue 368, p56*) is 6.1mm thick, while the Samsung Galaxy Tab S10 FE+ (*see p62*) matches its 6mm dimensions. Both those tablets are significantly more expensive, however: if you want 256GB of storage (and we humbly suggest you do) then you'll need to pay £899 and £749 respectively. If you're willing to put up with a thicker, 6.9mm frame, the 12.7in Lenovo Idea Tab Pro (*see issue 369, p72*), is a better-value choice: £400 buys you a 256GB model.

### Not so square

The 13.2 in screen has a practical 7:5 aspect ratio, giving it a shape that's more like an iPad than a widescreen Galaxy Tab. It uses LCD technology like the iPad Air, rather than OLED as found on Samsung's more expensive tablets. But don't think that means poor visuals: it still looks brilliant, with excellent brightness (we measured it at 530cd/m²) and superb colour accuracy with an average Delta E of 0.23. However, the Galaxy Tab S10 FE+ wins with its 92% coverage of the DCI-P3 gamut compared to 79% for the OnePlus Pad 3 (similar to the iPad Air) and 76% for the Idea Tab Pro.



**LEFT** The OnePlus Pad 3 is slimmer than its predecessor, but the display is larger

**ABOVE** The OnePlus Pad 3 is a worthy alternative to the iPad

PC PRO RECOMMENDED

Display performance is smooth, thanks to a peak refresh rate of 144Hz. This automatically switches down through six lower frequencies when possible to save energy.

With a huge 12,140mAh battery (about 20% larger than the one in the 13in iPad Air), the OnePlus Pad 3 runs and runs. In our browser-based test, with adaptive refresh rate enabled, it lasted an astonishing 16hrs 21mins. This beat the 15hrs 43mins managed by the Samsung Galaxy Tab S10 FE+ and thrashed the 8hrs 22mins of the £999 Galaxy Tab S10+ (*see issue 364, p87*). Based on our recent tests of the 11in version, the best you can expect from the 13in iPad Air is around 12 hours, similar to the Idea Tab Pro.

You can recharge the OnePlus Pad 3 quickly, too, with support for 80W charging – although you'll need to buy a suitable charger separately to take advantage of this. I happened to have one, which took the OnePlus Pad 3 from zero to 20% in 15 minutes, and to 34% in 30 minutes. That might seem slow compared to phones, but when you consider the capacity of the battery it's a whole lot of screen time for a brief charging period.

**"At 6mm, the Pad 3 is palpably thinner than the OnePlus Pad 2, while the display is more than an inch bigger than its predecessor"**

### Elite speed

The Pad 3 is the first tablet we've seen based on Snapdragon 8 Elite chipset, hitherto found only in the latest premium Android phones. As I've mentioned, the 256GB model comes with 12GB of RAM, but I tested the 512GB version that comes with 16GB and uses faster LPDDR5T modules.

This performed just as well as I'd hoped, destroying similarly priced Android competitors in graphics-based tests and running ahead on

CPU performance, too. For example, in 3DMark Wild Life Extreme Unlimited it averaged 5,121 compared to 1,352 for the S10 FE+ and 2,194 for the Idea Pad Pro. Or consider their Geekbench 6 multicore results, with the Pad 3's 8,993 more than doubling the 3,923 return of the S10 FE+ and 4,455 for the Idea Pad Pro.

It should be no surprise that everything feels zippy, even while gaming: a long session of *Ex Astris* at maximum settings looked stunning, with only a couple of frame-rate hiccups during loading.

Predictably, the Pad 3 can't match the raw performance of the iPad Air, which uses a desktop-class processor. When we tried resizing a video file from 4K to 1080p the iPad completed the task in around a third of the time it took the Pad 3, so for that specific workflow you're better off with Apple. It's faster in Geekbench (11,943) and 3DMark (6,499), too, but the OnePlus Pad 3 isn't far off.

## Sound & vision

The OnePlus Pad 3's audio provision is technically impressive, featuring not four speakers (like most rival tablets) but eight. These produce an amazingly wide soundstage effect, and they also enable a neat feature called Holo Audio, which uses directional audio to pick out particular sounds. For example, while playing music in regular stereo, you can have voice calls come in from the left and notifications from the right, helping you to easily distinguish the sound sources. It's a clever idea, and can be customised in surprising depth if you want.

I do, however, have to dock points from the OnePlus Pad 3 for being the least bassy tablet I've ever tested. Audio separation is generally good, but I found the low end was almost completely absent, making it hard to fully enjoy music.

Photography is rarely a priority with tablets, but the OnePlus Pad 3's 13MP rear camera impressed me, making everything look warm and inviting. The front camera has a lower 8MP resolution, but still produces a nice colour balance. It can be used to quickly unlock the tablet via facial recognition too – although this isn't as secure as a physical fingerprint scanner, which the OnePlus Pad notably lacks.

If you want to use the Pad 3 as a laptop replacement, you can invest in the new £169 Smart Keyboard case – discounted to £85 if you buy it as a bundle – which comes with an adjustable kickstand. It offers larger keys than OnePlus' previous keyboards, and the pogo pin connector is now much flatter, attaching to the back of the tablet for easy positioning and transport. The UK version doesn't support Bluetooth, however, so you can't use it to control the tablet from afar.

There's also a £59 folio case (or £30 as an add-on to your order), for those who just want to protect their tablet, or stand it up either vertically or horizontally. It comes with a magnetised fastener to keep the folio closed, and the Stylo 2 stylus can snap onto the case too – a capability oddly missing from the Smart Keyboard.

The Stylo 2 supposedly costs £99, but you can select it as a free gift during the buying process. Haptic feedback helps make writing on the smooth screen feel more natural and tactile than lesser pens, but I wish that it attached more firmly to the OnePlus Pad 3 when in transit: I kept accidentally knocking it off when putting it in or taking it out of my bag.

**LEFT** You can select the Stylo 2 stylus as a free gift when buying

## AI, of course

OnePlus' OxygenOS 15 platform works excellently on phones, and I'm pleased to say it translates well to the larger tablet screen. Here it includes a taskbar with a list of recent files and a built-in app drawer, and lets you use a two-pane app view for easy multitasking, or arrange up to three apps in your own custom layout.

Some neat connectivity options help you work with other devices. As well as letting you share files directly to OnePlus phones and conveniently mirror their screens, the Pad 3 offers an unexpected level of interoperability with Apple-made gadgets. As well as integrated file sharing between the tablet and your iPhone, iPad and Mac, the tablet offers a Mac Remote Control feature that lets you securely access your Apple laptop or desktop (and its apps and files) from anywhere over the internet connection. It takes a bit of setting up, but it could prove hugely valuable for Mac owners – and it's something that iPads can't match.

**"Anyone looking for an upper-tier tablet should consider the OnePlus Pad 3. Even Mac or iPhone owners who would normally default to an iPad"**

All the usual AI features are included, such as document summaries, text generation and translation. These are accessed from a toolbar that you can swipe in from the side of the tablet at any time, but there are also dedicated buttons for these abilities in relevant apps. Circle to Search and Gemini are here too, for Google-powered image searches and AI requests.

There are only two things about the OnePlus Pad 3's software provision that hold it back from greatness. One isn't OnePlus' fault: it's the simple fact that Android doesn't have such a rich library of creativity and productivity apps as iPadOS. The other is the support window, which runs to a promised three major Android upgrades and six years of security updates. That's not dreadful, but it's behind the five-plus years that iPads normally get, and that Samsung guarantees for its Galaxy Tab models.

**ABOVE** An optional folio case can be used as a stand for the Pad 3

**BELOW** The Smart Keyboard has larger keys than OnePlus' previous keyboards

## Final decision

It's this simple: anyone looking for an upper-tier tablet should consider the OnePlus Pad 3. Yes, even Mac or iPhone owners who would normally default to an iPad. It's not a market leader in every way: the display isn't as stunning as the OLED ones found on premium devices from Apple and Samsung, the app selection is far more limited than the iPad's, and if you're looking for raw number-crunching performance, Apple's M-series processors take the prize.

For everyday multitasking, battery life and overall value, however, the OnePlus Pad 3 is an outstanding device. **RICHARD PRIDAY**

### SPECIFICATIONS

8-core Qualcomm Snapdragon 8 Elite SoC • Adreno 830 graphics • 12GB/16GB RAM • 13.2in 144Hz IPS touchscreen, 3,392 x 2,400 resolution • 256GB/512GB storage • 13MP rear camera • 8MP front camera • Wi-Fi 7 • Bluetooth 5.4 • USB-C 3.2 Gen 2 • 12,140mAh battery • Android 15 with ColorOS 15 (three OS updates) • 290 x 6 x 210mm (WDH) • 675g • 2yr warranty

# Your bonus software

**Total value this month £153**

We scour the globe to negotiate the best software deals for our readers, from extended licences to full programs you don't need to pay a penny for. Here's this month's lineup

## AnyTech 365 IntelliGuard Pro

AnyTech365 IntelliGuard (21.11.1034.0)
AnyTech365 IntelliGuard
Home
System Tools
Security
Clean Tools
ULTIMATE
AI Assistant
System Health
Go back
Processor
Your device's processor usage is currently at 6%, which is within the optimal range (0 - 30%) for a CPU.
6%
Memory Optimizable
Your device is utilizing a large portion of memory 74%, which could slow down operations.
74%
Disk
The main disk is currently at 33% capacity, ensuring sufficient free space to maintain optimal performance.
33%
by AnyTech365 AI Powered IT Security

**One-device, one-year licence worth £39**
**anytech365.com**
**REQUIRES Windows 10; 270MB drive space; in-application registration**

Sometimes you want to consolidate as many apps and system tools into as few packages as possible. AnyTech 365 IntelliGuard Pro aims to do just that: it provides a wide range of system optimisation and monitoring tools, along with access to support (both in-person and AI) and security options such as encrypted folders and a secure password manager.

Setup is simple. Start by downloading and running the compact installer, which will obtain the latest version of the program for you and install it automatically, while providing a carousel of key program features. Once that's complete, the main interface will appear, ready for you to register the program and explore those features.

The IntelliGuard Pro interface provides a simple "System Health" score, based on your processor, memory and hard drive usage. However, before you can use of the suite's any other tools, you'll be prompted to log in to an AnyTech 365 IntelliGuard account. To do this, click the Create Account button and fill in the form. The usual personal details are requested, including an email address and secure password. After signing up, you'll be sent an email verification code. When you've confirmed that your email address is accurate, you'll be sent the Pro registration key that's required to unlock the program's full set of features.

IntelliGuard helps you to optimise system performance, secure your personal data and get instant real-time access to world-class IT experts, all of which should give you peace of mind.

The Pro-only features that are unlocked via your registration include a tool for optimising system startup, through which you can view and selectively disable apps, Windows tasks and Services. There's also a simple password manager and a secure folder tool (note that you'll need to upgrade to Ultimate to add AES encryption). Finally, your Pro licence also adds a scheduler to the system cleaner, which simplifies the task of periodically cleaning up your PC automatically.

These tools come on top of numerous features incorporated into the free edition of IntelliGuard, including a software manager and internet speed tester. IntelliGuard works unobtrusively in the background, identifying areas for improvement such as outdated software, issues that are slowing down your computer and potential security vulnerabilities.

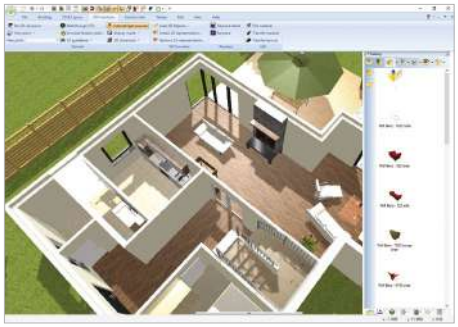
**ABOVE Internet connection running slow? Use IntelliGuard's built-in speed tester to keep an eye on performance over time**

**ABOVE Understanding your PC's internal make-up can help when you need to seek support – and IntelliGuard reveals its key specs**

**ABOVE With the Software Manager, you can browse, modify and remove any applications installed on your PC**

# Ashampoo Home Design 10

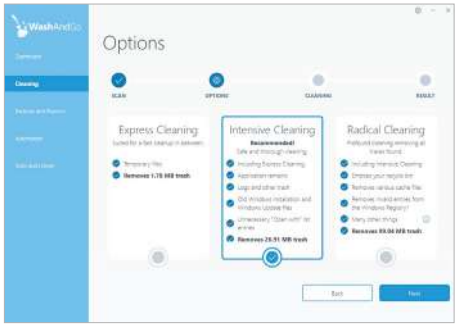
- Whether you're building a house or indulging in a little remodelling, this app will help you get started
- Work in 2D or 3D mode – or a combination of the two. Walk through and fly around your creations
- Includes a library of 3D objects to help you furnish your planned home or garden with ease



**Full product worth £44 ashampoo.com**
**REQUIRES Windows 8 or later; 500MB drive space; online registration**

# Abelssoft WashAndGo 2025

- Declutter your PC to regain its original performance and recover drive space
- Uses a deep knowledge of Windows and applications to locate surplus files and Registry keys, assuring a thorough system clean
- Automatically backs up the files it deletes and keeps backup copies for two weeks




**Full product worth £20 abelssoft.net**
**REQUIRES Windows 7 or later; 50MB drive space; online registration**

# Audials Radio 2025.2 SE

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- Clean up personal data and purge unwanted files

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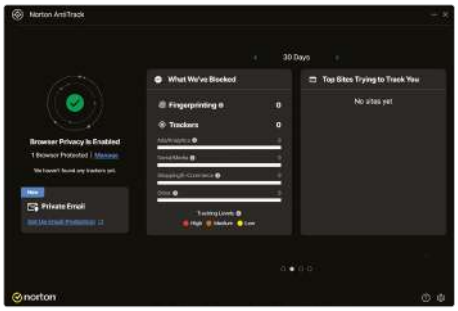


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**norton.com REQUIRES Windows 10, macOS 11, iOS 15, Android 8 or later; online registration**

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- Browser extensions available for Edge, Chrome and Firefox
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**2** Once you're in the download area, you can access this month's bonus software by navigating to the relevant product page and clicking the red Install button. For trial software, freeware and other downloads, click the Install button below the product description, or follow the onscreen instructions (please make sure to read these carefully).

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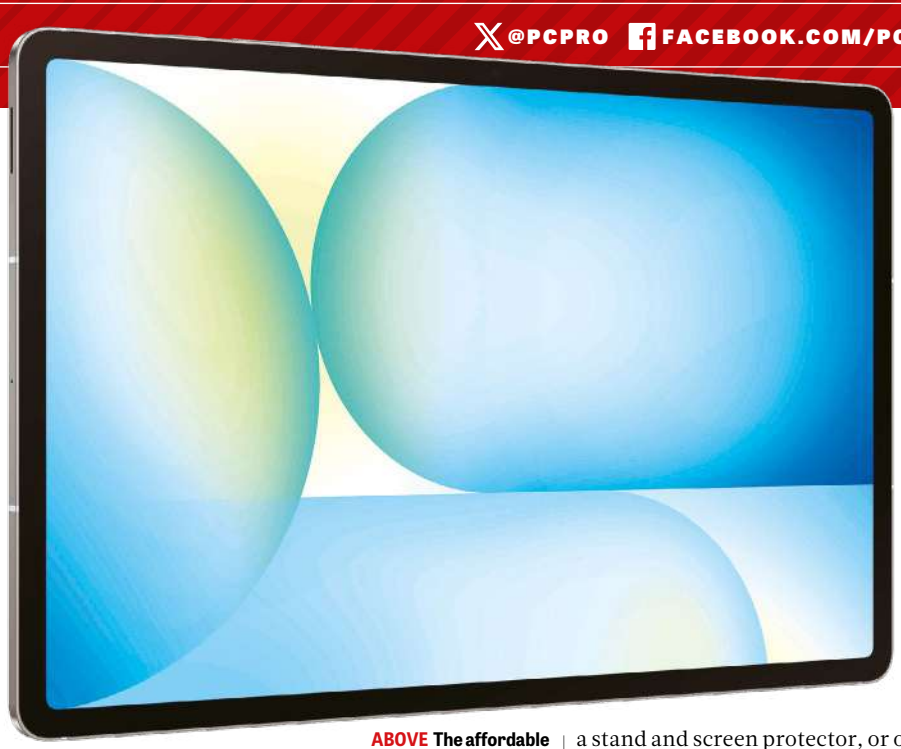
*Codes are sometimes limited, so please claim early to avoid disappointment

# Samsung Galaxy Tab S10 FE+

## A perfectly nice tablet, but it's made to look expensive and underpowered by the OnePlus Pad 3

**SCORE** ★★★★☆

**PRICE** 128GB, £541 (£649 inc VAT)
**from** samsung.com



Samsung's Galaxy Tab FE tablets provide an affordable alternative to its S10 and S10+ models, attempting to cut the corners that most everyday users won't miss. That means a drop in power for the main chip and a drop in impact for the screen, but it's rare that you feel you're buying a second-class product: it still looks and feels premium.

Such is the case here. At 13.1in, its screen is 3in bigger than the plain S10 FE, giving a notable amount of extra space for your money: the 128GB models cost £499 for the S10 FE and £649 for the S10 FE+, while 256GB of storage ups that to £599 and £759.

Even with the extra room, the S10 FE+ is noticeably more rectangular than most tablets, especially the 13in iPad Air (*see issue 368, p56*) and OnePlus Pad 3 (*see p60*). At 6mm it's just as thin as those devices, although Samsung earns extra points for its IP68 certification. Colour-wise, your options are a subdued if professional grey, silver or blue.

There's much to like about the 13.1in IPS panel. Stick to the default Vivid mode and it covers 92% of the DCI-P3 gamut, with excellent colour accuracy and a peak brightness of 782cd/m². All those figures are better than the OnePlus Pad 3, as we discuss in that review. It's a shame that Samsung keeps the anti-reflective coating for its non-FE models, but it's still brilliant for watching films or browsing. And while the 90Hz refresh rate lags behind Android rivals, it looks smooth compared to the 60Hz tech that Apple still uses on all its iPads, other than the Pro models.

Where the S10 FE+ struggles is performance. Samsung's lowly Exynos 1580 chip produces almost embarrassing results in benchmarks. Take Geekbench 6, where its return of 1,362 in the single-core test compares to 2,980 for the OnePlus Pad 3; that gap only widens in the multicore section, with 3,923 versus 8,993.

It's a similar story for graphics, with a 1,352 result in 3DMark's Wild Life Extreme Unlimited compared to 6,410 for the Pad 3. If you want power, and you want Samsung, you need to buy the S10+ with its MediaTek Dimensity 9300 Plus chip: that scored 2,137/7,130 in Geekbench 6 and 5,021 in 3DMark.

This lack of power was noticeable outside of our tests, too. When I played *Ex Astris*, a demanding RPG, the S10 FE+ simply couldn't keep up. Only taking my party indoors and into tight corridors pushed the frame rate back up, but even then it struggled when I did anything more involved than moving around the rooms. Nor should you expect immersive audio, although the stereo speakers here offer enough power and definition to make listening to music pleasurable.

Samsung keeps things simple when it comes to photography, with a 13MP camera on the rear and a 12MP unit on the front. They're fine for snaps and for video calls, which is all most people need on a tablet.

There's good news on battery life, with 15hrs 43mins comparing well to rivals. With a 45W charger (£44), it went from zero to 8% in 15 minutes and 16% after half an hour; not bad, but the OnePlus Pad 3 charges more quickly.

As usual, Samsung bundles its S Pen with this tablet. The built-in button and rubbery tip make it an excellent precision writing or drawing tool. You can also buy a Smart Book Cover (£79), which doubles as a stand and screen protector, or one of two keyboard covers: one with a trackpad, one without. Unfortunately I didn't get a chance to test either.

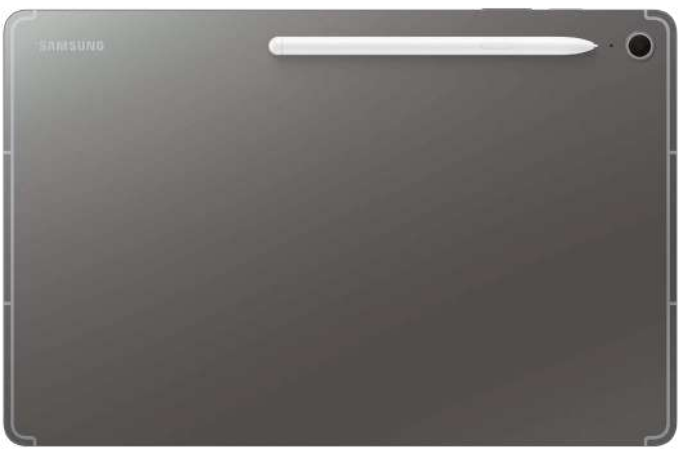
They're worth considering if you want to take advantage of Samsung's DeX desktop mode, part of its excellent One UI 7 interface. Don't expect much in the way of AI (although you still get Circle to Search and Solve Math inside the Notes app), but it's great to see a promise of six years of updates.

**"It's simply too slow for a tablet at this price, and you wonder how sluggish it might feel at the end of its life"**

Still, this isn't enough to push the S10 FE+ into the awards-winning category. It's simply too slow for a tablet at this price, and you wonder how sluggish it might feel at the end of its life. The only reason to buy it over the OnePlus Pad 3 is if you're a Samsung loyalist.
**RICHARD PRIDAY**

**ABOVE** The affordable Galaxy Tab S10 FE+ is underpowered compared to rivals

**LEFT** Despite the poor performance, the S10 FE+ looks and feels like a premium device




**BELOW** The bundled S Pen is an excellent addition to the tablet

### SPECIFICATIONS

8-core Samsung Exynos 1580 SoC • Xclipse 540 graphics • 8GB/12GB RAM • 13.1in 90Hz IPS touchscreen, 2,880 x 1,800 resolution • 128GB/256GB storage • 13MP rear camera • 12MP front camera • Wi-Fi 6E • Bluetooth 5.3 • USB-C 2 • 10,090mAh battery • Android 15 with One UI 7 (six OS updates) • 301 x 6 x 195mm (WDH) • 668g • 2yr warranty

PC PRO

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# Dell Pro Compact Silent Keyboard and Mouse (KM555)

## It's impossible to argue with the price or the software, but the keyboard's lack of precision can be irritating

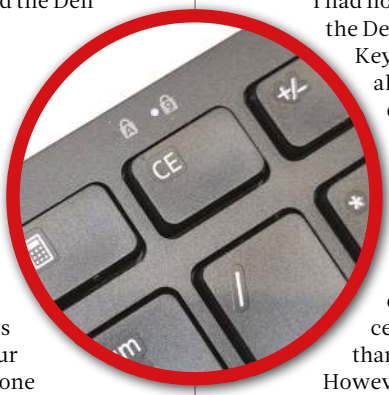
**SCORE** ★★★★☆

**PRICE** £43 (£51 inc VAT) **from** dell.com

ABOVE **This wireless keyboard and mouse set has a battery life measured in years**

Forgive me for sounding like a broken record these past few months as I do Dell's job for it, but at CES in January it rebranded its entire ecosystem of laptops, PCs and peripherals. Well-established sub-brands such as Latitude, XPS and UltraSharp are on the way out, with Dell Premium for high-end products and Dell Pro the universal label for devices aimed at professionals.

This universality extends to keyboards, as shown by the Dell Pro Compact set here and the Dell Pro Collaboration keyboard opposite. A month after its big rebrand, Dell introduced its Dell Display and Peripheral Management software, which is surprisingly useful from an end user's perspective. It allows you to control all your Dell hardware from one place – updating its firmware, perhaps – and in the example of this keyboard and mouse combo means you can customise shortcuts. (At some point in the future, IT managers should be able to use Dell's Device Management software to control their assets, but I don't have a date for when that will happen.)



LEFT **Blink and you'll miss the indicator light for Caps Lock**

With this keyboard, users can use the software to reprogram the 12 function keys plus the Print Screen, Home, End, Pg Up and Pg Dn buttons that sit between the main keys and the number pad. You can also reassign the Calculator button. All the usual shortcut options are here, but it doesn't have the AI focus that you'll find in Logitech's more ambitious Options+ software.

Dell Pro Compact Silent Keyboard
KB555
Key Customization
To customize a key, click one of the outlined keys on the image to the left

BELOW **If you buy into the Dell universe, the software is a definite boon**

It's a membrane keyboard with a plunger mechanism. That means plastic stems in the keycaps press down on a rubber dome to register contact, which results here in a good amount of travel but a fuzzy actuation point. Anecdotally, I'd say that 95% of the time it works perfectly well, with my prods and presses resulting in the correct letter or space emerging. However, that one in 20 became annoying after a while. The spacebar needs particular precision, and if I started to type more quickly I found the keyboard didn't register presses quite as well.

I had no problems with the Dell Collaboration Keyboard, despite it also using a plunger design. But then that keyboard is more expensive.

Although Dell describes this combo set as compact, it's only a couple of centimetres slimmer than a normal keyboard. However, it does live up to its Silent moniker. Even noisy typists who bash with full force will struggle to annoy their neighbours.

This quietness extends to the mouse, with subdued clicks for its left and right buttons, but the Logitech mouse opposite is quieter still. Dell's is an extremely basic mouse, with the only excitement stemming from its clickable scroll wheel. Again, this can be customised in Dell's software. An ambidextrous design means it fits snugly in either hand, but it would benefit from more weight.

One word curiously absent from the product's name is "cordless", for there are no wires here. You can either connect using Bluetooth or the supplied USB-A dongle, which the two products share. This means you can connect the KM555 combo to two computers and flick between those two wireless options. The keyboard's connectivity is set via a button at the top right, the mouse underneath.

**"IT managers looking to update their tired keyboards and mice should certainly bear the KM555 combo set in mind"**

Dell provides a generous three-year warranty here, and it also claims that the batteries will last for three years. The keyboard uses two AAA batteries, the mouse a single AA cell. This excellent life is partially due to the lack of indication lights: if you press Caps Lock a white LED will briefly appear before fading away, and it isn't on the key itself but above the number pad – so easy to miss.

The longevity of the battery and the price – it's listed at £43 exc VAT but appears to be permanently discounted to £32 exc VAT – mean this combo is quite the deal. Admittedly, that price is reflected in both features and quality, but IT managers looking to update their tired keyboards and mice should certainly bear the KM555 combo set in mind. Even if they quietly stick to Logitech for their own peripherals. **TIM DANTON**

### SPECIFICATIONS

**Keyboard:** Plunger key switches • 2 x AAA batteries • 399 x 127 x 26mm (WDH) • 406g. **Mouse:** 4,020dpi • 3 buttons (left, right, scroll) • 1 x AA battery • 38 x 105 x 60mm (WDH) • 67g. **Both:** Bluetooth 5.1 • 2.4GHz RF wireless USB-A adapter • 3yr advanced exchange warranty

# Dell Pro Wired Collaboration Keyboard (KB525C)

## A near-silent keyboard that's a great choice for workers who spend their days on Teams and Zoom calls

SCORE ★★★★☆

**PRICE £34 (£41 inc VAT) from dell.com**

Most of what you need to know about this keyboard is written in its name. It's wired, it's designed for collaboration – which is Dell code for the endless stream of video calls that fill many people's workday – and it's aimed at professionals. It's also a keyboard.

Let's tackle the collaboration aspect first. This boils down to four shortcut keys that sit unlit at the top right of the keyboard, above the number pad, until you start a Teams or Zoom call. (I tried it with Google Meet but no luck.) By default they're all white, but if you press the video button it will switch off your webcam's feed and turn red; likewise for the mic button. These simple visual cues make it incredibly obvious whether people can see or hear you. The other buttons are for sharing a window and activating the chat interface, both of which will no doubt come in handy.

**ABOVE The KB525C would be a fine choice for business rollouts**

**BELOW Shortcut buttons light up when your webcam is live**

Fire up the Dell Display and Peripheral Manager, as covered opposite, and you can choose to activate or deactivate these buttons, but there's no way to reprogram them. Not that there's much need for this, as all 12 function keys can be turned into shortcuts for whatever you wish.

As a keyboard, the KB525C works far better than the Dell KM555 opposite despite using the same plunger technology. Dell could easily have added the word "Silent" to this keyboard's name here too: keys are heavily dampened so make little noise when you type. If it weren't for the cable – I've become too used to wireless devices – I would happily use this as my main keyboard.

I've quoted Dell's official price of £41 inc VAT, and it's expensive for what you're getting. However, offers often come up and I've seen it for closer to £30. That would make it highly attractive for business rollouts and home workers alike. **TIM DANTON**

**SPECIFICATIONS**

USB-C (USB-A adapter) ● 1.8m cable ● plunger switches ● 433 x 122 x 26.2mm (WDH) ● 458 ● 3yr warranty

# Logitech Slim Wired Combo MK620 for Business

## Pricey for what you get; the scissor key switches are crisp but noisy and the mouse slick but basic

SCORE ★★★☆☆

**PRICE £63 (£75 inc VAT) from logitech.com**

One of Logitech's big sells for this wired keyboard and mouse combo is that the keyboard has a similar keystroke to a laptop's, allowing users to be "instantly familiar" with its "fluid keystrokes". I think the copywriter needs to have a lie down; yes, some people will appreciate the short, sharp (and noisy) click of this keyboard, but I didn't notice my keystrokes becoming any more or less fluid.

In terms of function, most everything is here, and much of it comes courtesy of Logitech's neat Tune software. This allows you to reprogram all the function keys and the various icon shortcuts – so the cut, copy and paste buttons that sit above the insert, home and page up key scan be turned into any shortcut you wish. For example, open a favourite app, hide the desktop, skip a music track. The choices are almost endless.

**ABOVE The keyboard is designed to have a similar feel to a laptop**

If you install Logitech Options+ then this will wrest control away from Tune and give you access to advanced tools such as Logitech's AI Prompt Builder. This gives you one-click access to ChatGPT prompts without leaving the app you're in. Great if you want to rewrite a paragraph, say. I've used AI Prompt Builder before and it works well, but when I installed Options+ this time it didn't recognise my mouse or keyboard. Logitech assures me that by the time the MK620 set goes on general sale it will work.

Back to the hardware. If you regularly switch between OSes you may appreciate the key nestling above the video on/off button, which shifts between macOS, Chrome OS and Windows. For example, in the latter, the AI key (to the left of the cursors) will launch Copilot, or Gemini if switched to Chrome.

Then there's the mouse, which is far quieter than the keyboard. It includes only four buttons, one of which is nominally used for switching between the dpi settings (useful if you want greater acceleration) and the other is the clickable scroll wheel. The latter are reprogrammable via Logitech Tune, and I ended up changing the dpi button to a shortcut to open Windows Explorer. Whether left- or right-handed, you should appreciate the way this mouse fits snugly into your hand.

**BELOW The simple mouse is extremely quiet in use**

I'm left with mixed feelings about this Logitech combo. The mouse is simple but pleasant to use, but I never fell in love with the clicky keyboard; I was more than happy to replace it with the quieter Dell Collaboration Keyboard, which is arguably a better match for the similarly demure mouse. **TIM DANTON**

**SPECIFICATIONS**

**K620 keyboard:** USB-C ● 1.8m cable ● scissor key switches ● 434 x 135 x 23.1mm (WDH) ● 707g ● **M520 mouse:** USB-C ● 1.8m cable ● 400 to 4,000 dpi ● 4 buttons (left, right, scroll, dpi) ● 39 x 108 x 61mm (WDH) ● 105g. **Both:** 2yr limited warranty

# Shootout Wi-Fi 7

## Asus RT-BE58U

SCORE ★★★★★

PRICE £83 (£99 inc VAT) from amazon.co.uk

## TP-Link Archer BE550

SCORE ★★★★★

PRICE £150 (£180 inc VAT) from amazon.co.uk

Since the latest Wi-Fi 7 standard debuted at the start of last year, we've seen a steady trickle of routers coming through the *PC Pro* Labs. Most of them from Netgear, which has been busily building a range of routers, from the premium Nighthawk RS700 (*see issue 353, p76*) down to the cheap but functional Nighthawk RS100 (*see issue 370, p65*), currently selling for £120 inc VAT.

This month brings not one but two persuasive competitors. Rather than contesting the high ground, they both promise affordable Wi-Fi 7 with good-enough levels of performance.

### A tale of two routers

At £99 inc VAT, the Asus RT-BE58U is the cheapest Wi-Fi 7 router we've yet seen. The TP-Link Archer BE550 aims higher, with more bandwidth for both wireless and wired connections. While not quite so aggressively priced as the Asus, it's by far the cheapest tri-band Wi-Fi 7 router on the market: Netgear's equivalent Nighthawk RS300 will cost you £240 (*see issue 361, p72*).

These different approaches are reflected in the very different physical designs of the two routers. The Asus RT-BE58U is small, plasticky and unassuming, with four spindly plastic aerials sticking up at the back. You can hunt all around the casing and the most upmarket feature you'll find is a single 2.5Gbits/sec Ethernet port; the other four sockets are limited to standard gigabit speeds.

The BE550 conversely looks more expensive than it is. Its eye-catching design features a pinched waist and a mixture of matte and glossy finishes; when you power it on a column of LEDs lights up at the front, which pulse while the router is booting up. The rear is plain, but TP-Link provides 2.5GbE on all five Ethernet ports, giving you a ton of wired bandwidth. Both routers also include a single 5Gbits/sec USB Type-A port, so you can easily hook up and share a local storage device.

### Wireless speeds

Most devices will be connecting wirelessly, and the RT-BE58U offers a modest but workable dual-band Wi-Fi specification: like the Nighthawk RS100, it combines a 2.4GHz radio rated at up to 700Mbits/sec with a 2.9Gbits/sec 5GHz transmitter. There's no support for 6GHz connections, nor for the expanded 320MHz channel width introduced with Wi-Fi 7, but the 5GHz network does benefit from the new 4K-QAM and preamble puncturing features. That means you can expect download speeds around 20% faster than you'd see from a comparable Wi-Fi 6 router, with better resistance to interference from nearby networks or electrical appliances – as long as you're connecting from a Wi-Fi 7-compatible device.

**"While not quite so aggressively priced as the Asus, the BE550 is by far the cheapest tri-band Wi-Fi 7 router on the market"**

The BE550 matches the Asus' specs on the 2.4GHz and 5GHz radio bands, but adds a 6GHz transmitter rated at 5.8Gbits/sec, giving you over twice as much total bandwidth. This radio supports the ultra-wide 320MHz channel width, and you can optionally enable an MLO (multi-link operation) network that combines the 5GHz and 6GHz networks into a single connection, potentially improving performance and stability.

Of course, when it comes to Wi-Fi performance, specifications only tell a part of the story. To find out how the routers perform in real life, I connected each one to an Asustor Drivestor 4 Pro NAS appliance over 2.5GbE, and used a Wi-Fi 7-enabled laptop to measure download speeds in different parts of my home. You can see how they did opposite, along with speeds from the Nighthawk RS100 for comparison.

**BELOW** The Asus RT-BE58U is the cheapest Wi-Fi 7 router we've seen

Both routers performed very respectably on the 5GHz network. The Asus effectively matched the pricier Nighthawk RS100 in the study and dining room, and outpaced it in the bathroom and the living room; the TP-Link was even faster

# routers

These Wi-Fi 7 routers both offer strong performance and features at great prices – you can't go wrong

in the study and bathroom, although performance dropped off in the dining room. If I had to guess, I'd say this was to do with MIMO – all three routers support 2×2 MIMO, but it looks as if the Asus and Netgear routers managed to establish a dual-stream connection to this location, while the TP-Link could only provide a single stream.

I also tested the TP-Link on the 6GHz band. Higher-frequency signals offer higher data rates but worse penetration – this is why you mostly hear the bass when your neighbour's playing music – and that was reflected here. It provided excellent performance over the 6GHz network at close range, with downloads racing over the airwaves at 143MB/sec in the study and 105MB/sec in the bathroom, but speeds dropped to only 18MB/sec in the dining room.

Finally, I used the TP-Link's MLO support to try connecting and downloading over the 5GHz and 6GHz networks at once. I'd hoped that this might give me the best of both worlds, but rather than building on the speed of the 6GHz network I found the MLO configuration dragged it down slightly, with downloads falling to 120MB/sec in the study and 16MB/sec in the dining room. Still, a multi-band connection should be more robust than a standard Wi-Fi link, so it's good to have the option for scenarios where reliability is more important than raw speed.

While these routers both hold up well in their price range, a more expensive model can provide faster downloads. The Netgear RS700S gave me a massive 135MB/sec downstream in the study, and topped 90MB/sec in the bathroom and living room.

For most people, though, that's an academic point. We're lucky to live in an age where the available bandwidth is usually far in excess of our needs: Disney+ recommends a connection speed of 25Mbits/sec for 4K HDR video streaming. That's equivalent to just over 3MB/sec, indicating that even the TP-Link's worst performance is enough to stream five or six movies at once, at maximum quality. Do you really need more? Honestly, I doubt it.

## Software features

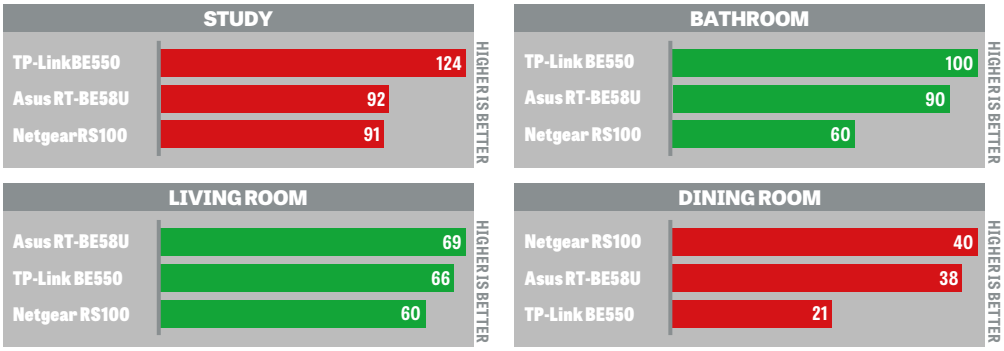
Both routers also outshine the competition when it comes to software. Where Netgear's standard firmware sticks to a fairly simple set of functions, Asus' highly configurable management platform comes loaded with fancy add-ons such as built-in network security, parental controls and both inbound and outbound VPN support. USB support is particularly versatile: as well as sharing files, this router can host a Time Machine volume for macOS backups, a 4G mobile internet adapter or a local printer for sharing over the network.

I was impressed by the RT-BE58U's flexible Wi-Fi options, too. Even though this is a budget home router, it lets you define and provision custom SSIDs for guests and smart home devices, just like an enterprise router. You can even enable MLO across the 2.4GHz and 5GHz bands, although this comes with a considerable performance compromise.

If I've a criticism, it's that all these options make the web interface complicated and intimidating for less technical users. There is a companion mobile app, but this too is packed with pages and sub-pages of advanced settings. It doesn't help that the presentation and layout of the app is completely different to that of the web console, so familiarity with one doesn't really help you master the other.

TP-Link's router doesn't offer such a huge range of features, but both the web interface and the smartphone app are cleaner and more intuitive than Asus' offering. Again, you get plenty of control over your networks: you can choose to broadcast all three under one name or split them up, as well as optionally enabling the MLO network. You can create guest networks on all three bands, too, along with isolated IoT networks on the 2.4GHz and 5GHz bands, adding up to a potential nine different networks all running at once.

**DOWNLOAD SPEEDS, 5GHz (MB/SEC)**




Two-way VPN support is another bonus, along with limited security and parental control functions; these are quite bare-bones, however, and to unlock their full capabilities you'll need to pay annual subscriptions of £35 and £18 per year respectively.

**"As Wi-Fi 7 grows into a mainstream technology, both the Asus RT-BE58U and the TP-Link Archer BE550 have plenty to offer"**

## Take your pick

As Wi-Fi 7 grows into a mainstream technology, both the Asus RT-BE58U and the TP-Link Archer BE550 have plenty to offer. I'm not saying you should rush to buy either of them: Wi-Fi 6 is fast and flexible enough for most homes, and for everyday web browsing or video meetings you'll probably notice few benefits from these newer models.

However, if your old router is on its last legs – or if its dumb firmware is holding you back – either model would make an excellent upgrade, equipping you for the incoming generation of Wi-Fi 7-compatible devices for a very reasonable price. The Asus RT-BE58U in particular is a great deal for those on a tight budget, while for more demanding users the TP-Link's 6GHz radio and comprehensive 2.5GbE support make it a mid-range winner. Whichever one you choose, you won't be disappointed.

**DARIEN GRAHAM-SMITH**

**BELOW** All five Ethernet ports on the TP-Link Archer BE550 are the 2.5GbE variety

### SPECIFICATIONS

**Asus RT-BE58U** Dual-band 2.4GHz/5GHz router • 4 streams • 2.5GbE WAN, 4 x GbE LAN • 5Gbits/sec USB • 2GHz quad-core processor • 238 x 193 x 59mm (WDH) • 1yr warranty.

**TP-Link Archer BE550** Tri-band 2.4GHz/5GHz/6GHz router • 6 streams • 2.5GbE WAN, 4 x 2.5GbE LAN • 5Gbits/sec USB • 2.2GHz quad-core processor • 76 x 232 x 203mm (WDH) • 1yr warranty

# Honor 400

## Superb value thanks to a mesmerising display, decent performance and an affordable 512GB option

**SCORE** ★★★★☆

**PRICE** 256GB, £333 (£400 inc VAT)
**from** honor.com

It's clear where the Honor 400 draws its inspiration from: the flat edges and vertically aligned cameras give off more than a whiff of iPhone. But that's no bad thing when the Honor 400 costs less than half the price of Apple's handset.

Very much unlike an iPhone, Honor opts for a plastic chassis here, yet it still feels premium. And it looks good whether you opt for black, silver or gold finishes, while an IP65 rating means you won't have to worry about a spot of rain. It's a compelling design, especially for the price.

The display keeps up that impression. The 6.5in AMOLED screen is gorgeous, with a crisp 1,264 x 2,736 resolution and vibrant colours. A peak brightness of 5,000cd/m² means it's easy to use even under the harshest sun, while its adaptive refresh rate goes up to a smooth 120Hz. This has long been a feature of premium Android phones, so it's great to see it's now available at such a low price.

The main camera has a 200MP sensor with optical image stabilisation, and is partnered with a 12MP ultrawide that also serves as a macro lens. It's a shame you don't get a dedicated telephoto lens, but the huge resolution of the main lens lets you zoom in digitally in without wrecking the quality. I snapped fantastic shots of Surrey's Box Hill, and when I cropped in for social media I was happy with the results. For the maximum reach, Honor's 30x AI Superzoom feature generates an upscaled version of the picture you've just taken; results can be smeary, but it doesn't hurt to have the option.

Honor partners with photography studio Harcourt to add three custom portrait filters (vibrant, colour and classic) that add depth and immediacy to your images. The dedicated night mode does a respectable job too, so you should be in luck with most low-light situations.

Finally, Honor throws in an interesting AI-powered "image to video" feature that makes short animations out of shots you've taken. This works almost uncannily well: one video it generated from a selfie felt so realistic that I was thankful its output was capped at five seconds. What might it have made me do next?

From a performance perspective, the best thing I can say is that I didn't notice an issue over the course of testing the Honor 400. Its Qualcomm Snapdragon 7 Gen 3 chipset doesn't match up to the best (1,140 in Geekbench 6 single core, 3,180 multicore), but I experienced solid day-to-day performance, jumping happily from one app to another without any noticeable delay.

In games, the phone handled the frenetic energy of Asphalt Legends Unite with ease, and any stuttering was brief and infrequent. The stereo speakers help, with impressively loud and immersive performance.

Honor's MagicOS 9 system software isn't as slick as stock Android, but it does have a nice aesthetic with yet more nods to iOS such as Honor's take on the Dynamic Island; for example, this shows music playback at the top of the display. My biggest complaint is all the preinstalled bloatware, including TikTok and Temu.

Numerous AI features are also included. Honor's "Magic Portal" operates similarly to Google's Circle to Search, allowing you to circle part of an image or a passage of text using your knuckle, then quickly send it to another app. It works well, and I soon find myself using it to quickly look things up.

Other features such as AI Subtitles and AI Translate have their moments, but there's still work to be done. For example, when I tried to create subtitles from a YouTube video, it produced nonsensical text. AI Translate fares better, but doesn't support as many languages as the Live Translate feature on Samsung phones. One interesting feature is AI Deepfake Detection for video calls; this is a good idea, but would be more useful if it also worked for regular online video content.

Still, hopefully all of these features should become smarter and more comprehensive over time. And with a promised six years of updates, the Honor 400 should have a long life ahead of it.

While Honor doesn't make specific promises about battery life, I found the 400 lasted a long, heavy day of use, including video streaming and Wi-Fi tethering, and still had 30% left in the tank. That proved enough to dispel any battery anxiety.

Topping up is quick, with support for 66W fast charging. You don't get a fast charger in the box, but my 60W adapter took 30 minutes to go from 20% to 69%, and a total of 54 minutes for a full tank. The only letdown is that there's no wireless charging available.

Overall, the Honor 400 is a highly impressive proposition. Usually phones in this price range come with obvious compromises, but with the Honor 400 I never really noticed one. That's amazing when you consider that the price undercuts a ton of mid-range contenders, from the Google Pixel 9a (*see issue 369, p74*) to the Nothing Phone 3a Pro (*see issue 368, p76*). If you're looking for a low-cost phone, it's hard to fault what Honor has put together.

**THOMAS DEEHAN**

PC PRO RECOMMENDED

**ABOVE** The stunning 6.5in AMOLED display is a steal at this price

**"Usually phones in this price range come with obvious compromises, but with the Honor 400 I never really noticed one"**

**LEFT** The cameras include a 200MP main sensor that makes it easy to zoom in digitally

**BELOW** The styling borrows much from the Apple iPhone

### SPECIFICATIONS

8-core Qualcomm Snapdragon 7 Gen 3 SoC • 8GB RAM • Adreno 720 graphics • 6.6in 120Hz AMOLED screen, 1,264 x 2,736 resolution • 5G • 256GB/512GB storage • dual nano-SIM • IP66 • dual 200MP/12MP rear cameras • 50MP front camera • Wi-Fi 6 • Bluetooth 5.4 • NFC • 5,300mAh battery • USB-C 2 connector • Android 15 (6 major updates) • 75 x 7.3 x 157mm (WDH) • 184g • 2yr RTB warranty

# Honor 400 Pro

## The AI-enhanced camera, superb display and judicious compromises make this is a great alternative to flagships

SCORE ★★★★☆

**PRICE £583 (£700 inc VAT)**
**from honor.com**

PC PRO RECOMMENDED

ABOVE **The Honor 400 Pro is a powerful, robust smartphone**

The Honor 400 Pro isn't quite as cheap as the regular Honor 400 (*see opposite*), but it's still very reasonably priced for a "Pro" handset, costing £100 less than the Google Pixel 9 (*see issue 362, p60*) or the Samsung Galaxy S25 (*see issue 367, p72*),

Surprisingly, the design doesn't follow the iPhone-type stylings of the Honor 400. It has a more rounded look, with an aluminium frame that curves around gently and sits comfortably in the hand. The camera module at the rear is a sort of rounded trapezium shape; wonky looking but characterful.

All these curves disguise the fact that the Honor 400 is a big phone, weighing 205g. In return it's both solid and robust, with IP68-certified waterproofing. Colour choices are limited to Lunar Grey and Midnight Black.

LEFT **AI can turn still images into videos all too convincingly**

The display is simply brilliant – it's a 6.7in OLED panel with excellent colour accuracy. The screen supports a 120Hz peak refresh rate and a maximum brightness of 5,000cd/m², just as on the Honor 400. However, the notch at the top is larger, as it adds depth-sensing capabilities; if you like to watch video content full screen this might irk you, but it didn't bother me.

The main camera is again the same as that on the Honor 400, with a 200MP resolution and built-in optical image stabilisation. It takes sharp, high-contrast shots that look precisely as good as the ones from its cheaper brother. The big benefit of the 400 Pro is that it also has a 50MP telephoto camera, which produces sharp images at its full 3x optical zoom, and is still more than usable when you add digital magnification to reach 6x or even 10x. AI assistance is on hand to upscale images to 30x and beyond – the results vary wildly in effectiveness, but this can improve long-range shots given the right subject and shooting conditions.

The 50MP front camera takes decent selfies, aided by that additional depth sensor, with attractively blurred and clearly delineated backgrounds. Video capture options go up to 4K at 60fps – another upgrade from the Honor 400, which can manage only 30fps when filming at the top resolution. You can also use AI to turn still images into five-second videos, some of which are astonishingly convincing. The question is, when might you use this feature, beyond showing off the power of AI to friends and family?

Inside the Honor 400 Pro there's a Qualcomm Snapdragon 8 Gen 3 chipset, meaning this phone is as powerful as last year's most expensive Android handsets – and it comfortably outperforms the entire Pixel 9 range. Games such as *Genshin Impact* run fluidly on high settings, while demanding console racer *Grid Legends* speeds by at an appreciable lick. Multitasking is smooth, helped along by 12GB of RAM, and you also benefit from 512GB of storage.

My biggest reservation about this phone concerns Honor's Magic OS 9 software. This continues to be bogged down with bloatware, and you might love or hate the way it conspicuously borrows ideas from iOS, from the split notification pane to the lack of a dedicated app tray. You even get a version of Apple's Dynamic Island, here called Magic Capsule, which offers little widget-like bubbles of information around the extended selfie notch.

Still, Honor is hardly the only phone manufacturer to take a lead from Apple, and Honor's own AI features include winners. For example, Magic Portal provides a gloriously easy way to copy text and images between apps by circling items with your knuckle. Topping off the software provision is a new commitment to six years of OS updates and security patches, and Honor has also promised an Android 16 update before the end of 2025, a welcome focus on timely upgrades.

The 5,300mAh battery inside the 400 Pro saw me through a full day of heavy use with charge to spare. Indeed, a moderate day with around four hours of screen-on time left me with more than 60% charge remaining. With light use you could easily eke two days out of a full battery.

When it comes to recharging, Honor goes harder than it probably needs to, with support for wired charging up to a massive 100W. That can supposedly take you from empty to 51% in 15 minutes, but I wasn't able to test this as Honor doesn't supply a SuperCharge adapter in the box. For the same reason, I couldn't try out the claimed 50W wireless charging support, but it's good to know that you can expect such charging speeds if you invest in a top-rate charger.

**"It all adds up to a well-built phone with great water resistance, a gorgeous display and smooth performance"**

It all adds up to a well-built phone with great water resistance, a gorgeous display and smooth performance. The main camera captures high-quality photos in a range of lighting conditions, and the 3x optical zoom is a definite plus. The big battery with fast recharging certainly doesn't hurt, either.

Sure, there's nothing here that's unique, and the OS won't be to everyone's taste, but it's a compelling in-betweener handset, offering minimal compromise for a very reasonable price. Factor in the promised six years of updates and it's a terrific investment. **JON MUNDY**

BELOW **The main 200MP camera takes great-looking shots**

### SPECIFICATIONS

8-core Qualcomm Snapdragon 8 Gen 3 SoC • 12GB RAM • Adreno 750 graphics • 6.7in 120Hz AMOLED screen, 1,280 x 2,800 resolution • 5G • 512GB storage • dual nano-SIM • IP69 • triple 200MP/50MP/12MP rear cameras • dual 50MP/2MP front cameras • Wi-Fi 7 • Bluetooth 5.4 • NFC • 5,300mAh battery • USB-C 2 connector • Android 15 (6 major updates) • 76 x 8.1 x 161mm (WDH) • 205g • 2yr RTB warranty

# Motorola Edge 60 Pro

## A well-rounded Android phone that offers (almost) all the trappings of a flagship at a much cheaper price

**SCORE** ★★★★☆

**PRICE** £500 (£600 inc VAT)
**from** motorola.com

The Motorola Edge 60 Pro is the company's most expensive non-folding smartphone, but that price includes 512GB of storage. Compared to the 512GB Google Pixel 9 Pro (*see issue 362, p58*) or Samsung Galaxy S25 (*see issue 367, p72*) it's a bargain: those cost £919 and £959.

It comes in an exciting trio of Pantone-designed hues: I tried Dazzling Blue, but there's a greenish-khaki Shadow option or the vibrant Sparkling Grape. On the back is a raised camera bump, but as this doesn't stick too far out you can lie the handset flat on a surface without undue wobbling. The rear is textured, too, making it feel more premium than your average Android phone.

The Motorola Edge 60 Pro's other premium feature is a display that curves around onto the sides of the phone. While curved edges are divisive, the glass makes the phone very comfortable to hold, and the 186g weight is reasonably light. IP69 certification provides assurance against dust ingress and high-pressure beams of water, while the MIL-STD-810H accreditation means it should also withstand shocks, extreme temperatures, high altitude and strong vibrations.

The 6.7in screen has a tall 20:9 aspect ratio and a 120Hz refresh rate. That will be familiar if you've used a Motorola Edge phone before, but what's new is a brightness boost to 4,500cd/m² – more than enough for blazing sunshine. Colour performance is another strength, with support for HDR10+ and the DCI-P3 colour space, while the experience of watching films or playing games is enhanced by the built-in Dolby Atmos speakers.

The software is a more or less stock installation of Android 15 – Motorola has committed to four years of software updates – but Motorola has applied a few of its own tweaks. Those include advanced personalisation options that let you adjust big things such as your background, font and colour scheme, along with finer features such as the shape of icons and the animation that appears when you use the fingerprint unlock.

There's a new physical AI button on the side, which can bring up Motorola's AI assistant, open a note-taking function or quickly summarise your notifications. But not all will impress. For example, unless you've received an absolute deluge of emails since you last checked your phone, it takes longer to generate an AI summary than to check messages yourself. There's also a function that creates a bespoke playlist based on your mood, but it only supports Amazon Music.

Three cameras sit on the back: 50MP main, a 50MP ultrawide with a 120° lens and a 10MP telephoto with 3x optical zoom. The latter's depth of field is exquisite, but I found my pictures were often lifeless and dull, with none of the bright colours and bold contrast you'll get from an iPhone or a Samsung.

I also found the bokeh blur in portrait mode too intense by default, though you can change this. And when you put the phone near a close-up subject it automatically switches to macro mode, using the ultrawide lens – which is located further down the body than the other two, messing up your framing. It's a solid set of cameras on paper, but I was left disappointed.

The Edge 60 Pro is built on a MediaTek Dimensity 8350 chipset. It's fast enough that most people won't detect any difference between this and a top-end phone, even if the gulf is obvious in benchmarks: compare its 1,073 and 3,053 in Geekbench 6 (single core and multicore respectively) to 3,129 and 9,916 from the Galaxy S25 Edge. But the 12GB of RAM helps the handset feel responsive, and with 512GB of storage you've got space to store years of photos.

An equally gigantic 6,000mAh battery enables the Edge 60 Pro to breeze through a day of use, even withstanding lengthy gaming sessions. It can also recharge quickly: Motorola claims it will completely refill in 40 minutes if you're using an optional 90W charger, while my 45W charger took it to 80% in half an hour. Wireless charging is supported, too, albeit at a maximum of 15W; there's no support for reverse wireless charging.

**ABOVE** The Edge 60 Pro is a premium-feeling phone at a mid-range price

**"It doesn't technically match up to the likes of the Galaxy S25 or Pixel 9 Pro, but the look and feel are in a similar league"**

It says a lot about the Motorola Edge 60 Pro that, while testing it, I kept catching myself instinctively comparing it to premium phones. The truth is, it doesn't technically match up to the Galaxy S25 or Pixel 9 Pro, but the look and feel are in a similar league. The biggest compromise is camera quality; how I wish the Edge 60 Pro's pictures had more of a "wow" factor. If you can live without that, and cutting-edge power, you'll find that everything else you're looking for is right here for a great price. **TOM BEDFORD**

**LEFT** The rear cameras are solid but not spectacular

**BELOW** An IP69 rating means the Edge 60 Pro can withstand water and dust

### SPECIFICATIONS

8-core MediaTek Dimensity 8350 Extreme SoC ● 12GB RAM ● Mali G615-MC6 graphics ● 6.7in 120Hz AMOLED screen, 1,220 x 2,712 resolution ● 5G ● 512GB storage ● dual nano-SIM ● IP69 ● triple 50MP/10MP/50MP rear cameras ● 50MP front camera ● Wi-Fi 6E ● Bluetooth (version not specified) ● NFC ● 6,000mAh battery ● USB-C 2 connector ● Android 15 (4 major updates) ● 73 x 8.2 x 161mm (WDH) ● 186g ● 2yr RTB warranty

# Samsung Galaxy S25 Edge

## Notably thinner and lighter than your average phone, with battery life its biggest and predictable shortcoming

SCORE ★★★☆☆

**PRICE** 256GB, £916 (£1,099 inc VAT)
**from** samsung.com

Samsung's past Edge phones were notable for their curved screens, which wrapped round the sides like the Motorola Edge 60 Pro (*see p72*). This new model has a regular flat display, and instead distinguishes itself with a strikingly thin build. It's a feat of design and engineering, but it comes at a steep price in terms of cost and trade-offs.

There are three colours to choose from: Titanium Silver, Titanium Jetblack and Titanium Icyblue. Despite being 31% thinner than the Galaxy S25 Ultra (*see issue 367, p70*) and 29% lighter, it feels solid thanks to its metal frame and Gorilla Glass Ceramic 2 display covering. It also has the same IP68 rating as the S25 Ultra.

The 6.7in AMOLED screen is 0.2in smaller than the Ultra's, which makes it easier to use one-handed, especially as Samsung has kept the bezels slim. It looks sharp, with rich colours, a 120Hz refresh rate and lots of brightness, going up to a measured 1,997cd/m².

There's no sacrifice in power, with the same Snapdragon 8 Elite chipset found in the Ultra. With 12GB of RAM, it effortlessly handles all the apps and games you might want to run, even multitasking with multiple apps at once. In benchmarks it actually tops the S25 Ultra, though everything is so zippy on both phones you won't notice any difference.

One compromise is the camera arsenal: the Edge has a 200MP main shooter and a 12MP ultrawide camera, but no telephoto lens. Even as it is, the cameras stick a long way out from the body of the phone, so there's a fair amount of wobble if you lay it flat.

Samsung's manual photo and video modes give you plenty of control over your shots, and there's an option to shoot in raw. It's great for video, too, with 60fps recording at 4K or 8K at 30fps, along with LOG support and slow motion at 240fps.

Image quality is up to Samsung's usual standards: it hasn't confirmed that the Edge uses the same main camera hardware as the S25 Ultra, but the specs are the same and my test photos were of a similar standard, with beautifully controlled exposure and masses of detail. The dedicated macro mode also let me get very close to subjects, again performing just as well as the S25 Ultra.

The S25 Edge's all-digital zoom puts it at a disadvantage for long-range shots, with comparatively soft and smudgy results, but even at 4x zoom it's not awful. Overall this is a phone that's excellent for most shooting environments.

A bigger problem with the thin design is the constraint it puts on battery size. The 3,900mAh unit inside the Galaxy S25 Edge is small by modern standards, and in our simple web-browsing tests it delivered an average battery life of 12hrs 24mins, versus 17hrs 14mins for the S25 Ultra. I often found myself recharging before the end of the working day. This might not have bothered me too much if it had topped up quickly, but with a maximum charging rate of 25W I found that 30 minutes of charging only got me from an empty battery to 54%. The Galaxy S25 Ultra supports 45W charging, which took me to 71% in the same time.

Thankfully, there's no compromise with the software. Samsung's One UI 7 platform is superb for productivity, with custom features such as Multi Window, which allows you to run three apps simultaneously on its large screen, while DeX lets you connect the phone to a monitor for a full desktop experience. This is no gimmick, more than once allowing me to leave my laptop at home while travelling.

You also get all the Galaxy AI features we've already seen on other Galaxy S25 phones, including the Now Bar (which acts like Apple's Dynamic Island). I also like the Cross-app actions, which allow the AI agent to do things like find the next Cambridge United game and add it to my calendar. Although there's currently not much integration with third-party apps, the overall software package is as rich and deep as you'll find anywhere – and the Edge is promised a full seven years of major Android and security updates.

**ABOVE** The Edge is a stunningly slim phone with a bright, colour-accurate display

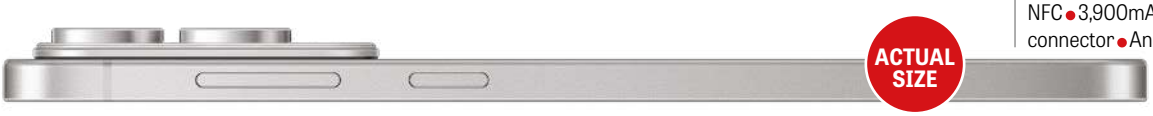
**"The Edge is a unique and stylish phone with many great plus points. What a shame its design comes at a cost"**

**LEFT** The superb cameras are exactly what you'd expect from a Samsung phone

There's no disputing that the Edge is a unique and stylish phone with many great plus points. What a shame its design comes at the cost of reduced camera capabilities and limited battery life. With a few refinements the slender format could make a compelling alternative to Samsung's regular lineup, but most people wanting the high-end Galaxy experience will have a better time with a more conventional variant, such as the S25+ or S25 Ultra. **JOHN VELASCO**

### SPECIFICATIONS

8-core Qualcomm Snapdragon 8 Elite SoC • 12GB RAM • Adreno 830 graphics • 6.7in 120Hz AMOLED screen, 1,440 x 3,120 resolution • 5G • 256GB/512GB storage • dual nano-SIM • IP68 • dual 200MP/12MP rear cameras • 12MP front camera • Wi-Fi 7 • Bluetooth 5.4 • NFC • 3,900mAh battery • USB-C 3.2 Gen 2 connector • Android 15 (7 major updates) • 76 x 5.8 x 158mm (WDH) • 163g • 2yr RTB warranty




**BELOW** Despite the slim design, the Edge feels solidly built

# EVERYDAY LAPTOPS

## Whether you're after a Chromebook or a Windows system, one of these dozen bargain-priced laptops should meet your needs

Not everybody has the budget for the latest flagship slim-and-light laptop, creative powerhouse or ultimate games machine. Luckily, as this group test proves, you don't need to. There are plenty of high-quality, stylish laptops around that cost under a grand, and you may be surprised to discover that many now run on Chrome OS.

In this test, we have two groups of people in mind. First, small businesses that aren't bothered with advanced features or the lowest possible weight; they're looking for a laptop that just works and feels comfortable to use. A solid all-rounder with enough performance to run a wide range of applications.

Second, anyone buying a laptop for home use or study. People who might not want to splash out on the latest, greatest models, but still want something that feels speedy, looks good and has a decent screen. And that will see you through the next three to five years.

That's what this month's Labs is all about. We're looking at everyday laptop PCs in a range of styles and specifications. When we approached manufacturers, our only constraint was that each product was available for under £999; where relevant review samples weren't available, a similar model in the same line had to be available for under the £999 mark.

We didn't want to stick to just Windows laptops, either, encouraging manufacturers to come in with their latest Chromebooks, as these can make a credible and easy-to-use alternative when you're trying to keep costs down.

What you'll find here may surprise you. There are fantastic slimline laptops, powerful and versatile big-screen options, plus generous helpings of AI. You no longer need to spend big to get a great laptop, as this month's stars will prove.

**CONTRIBUTOR Stuart Andrews**

## CONTENTS


Acer Swift 14 AI ..... 82
Asus Vivobook S15 ..... 83
Asus Zenbook A14 ..... 84
Dell 14 Plus ..... 86
HP OmniBook Ultra 14 ..... 87
Lenovo Yoga Slim 7x ..... 88
Samsung Galaxy Chromebook Plus ..... 89
Acer Chromebook Plus 514 ..... 90
Acer Chromebook Plus 516 ..... 90
Acer Chromebook Spin 312 ..... 91
HP Chromebook Plus x360 ..... 92
MSI Modern 15 F1MG ..... 92

Feature comparison table ..... 78
Buyer's guide: embrace the everyday ..... 80
Copilot+ PCs: the state of play ..... 85
Chromebook Plus with Gemini: the state of play ..... 91
How we test ..... 94
Performance graphs ..... 94
View from the Labs ..... 95

acer
dts x

| | Acer Chromebook Plus 514 | Acer Chromebook Plus 516 | Acer Chromebook Spin 312 | Acer Swift 14 AI | RECOMMENDED<br>Asus Vivobook S15 | Asus Zenbook A14 |
|---|---|---|---|---|---|---|
| **Overall rating** | ★★★☆☆ | ★★★★☆ | ★★★☆☆ | ★★★★☆ | ★★★★☆ | ★★★★☆ |
| **Purchase information** | | | | | | |
| Range starting price | £333 (£399 inc VAT) | £333 (£399 inc VAT) | £274 (£329 inc VAT) | £583 (£699 inc VAT) | £583 (£699 inc VAT) | £750 (£900 inc VAT) |
| Price of model tested [1] | £333 (£399 inc VAT) | £333 (£399 inc VAT) | £274 (£329 inc VAT) | £583 (£699 inc VAT) | £583 (£699 inc VAT) | £750 (£900 inc VAT) |
| Supplier | acer.com | acer.com | acer.com | currys.co.uk | currys.co.uk | asus.com |
| Part code | CB514-5H (range) | CB516-5H (range) | CP312-1H-C1GD | SF14-11-X6YU | S5507QA-MA012W | UX3407QA-QD244W |
| Dimensions (WDH) | 316 x 227 x 18.3mm | 359 x 253 x 19.3mm | 290 x 205 x 19.9mm | 313 x 218 x 14.9mm | 353 x 227 x 15.9mm | 311 x 214 x 13.4mm |
| Weight | 1.6kg | 1.7kg | 1.3kg | 1.3kg | 1.3kg | 980g |
| **Service and support** | | | | | | |
| Warranty | 1yr RTB | 1yr RTB | 1yr RTB | 1yr RTB | 1yr RTB | 1yr RTB |
| Manufacturer support/ reliability score [2] | 80%/88% | 80%/88% | 80%/88% | 80%/88% | 76%/87% | 76%/87% |
| **Core components** | | | | | | |
| Processor | Intel Core 3 100U | Intel Core 3 100U | Intel N100 | Qualcomm Snapdragon X Plus X1P-64-100 | Qualcomm Snapdragon X Plus X1P42100 | Qualcomm Snapdragon X 1-26-100 |
| Cores [3] | 6 (2P 4E) | 6 (2P 4E) | 4 | 10 | 8 | 8 |
| Threads | 8 | 8 | 4 | 10 | 8 | 8 |
| Max CPU speed | 4.7GHz | 4.7GHz | 3.4GHz | 3.4GHz | 3.4GHz | 3GHz |
| Supplied RAM | 8GB LPDDR5X | 8GB LPDDR5X | 4GB LPDDR5X | 16GB LPDDR5X | 16GB LPDDR5X | 16GB LPDDR5X |
| Empty RAM socket | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| Primary GPU | Intel Graphics | Intel Graphics | Intel Graphics | Qualcomm Adreno X1-45 | Qualcomm Adreno X1-45 | Qualcomm Adreno X1-45 |
| **Display** | | | | | | |
| Size and technology | 14in IPS | 16in IPS | 12.2in IPS | 14.5in IPS | 15.6in OLED | 14in OLED |
| Resolution | 1,920 x 1,200 | 1,920 x 1,200 | 1,920 x 1,200 | 2,560 x 1,600 | 2,880 x 1,620 | 1,920 x 1,200 |
| Pixel density | 162ppi | 142ppi | 186ppi | 208ppi | 212ppi | 162ppi |
| Frequency | 60Hz | 60Hz | 60Hz | 120Hz | 120Hz | 60Hz |
| Touchscreen | ✗ | ✗ | ✓ | ✗ | ✗ | ✗ |
| Glossy of matte? | Matte | Matte | Gloss | Matte | Gloss | Gloss |
| **Storage** | | | | | | |
| Model | WD SDINFD04-128 | Kingston CY14-128 | Not specified | WD SN500S | Samsung MZVL8512HELU-00BTW | Micron MTFDKBA1T0QGN-1BN1AABGA |
| Type | UFS 3.1 | UFS 3.1 | MMC | NVMe PCIe Gen 4 | NVMe PCIe Gen 4 | NVMe PCIe Gen 4 |
| Capacity | 128GB | 128GB | 128GB | 1TB | 512GB | 1TB |
| Empty SSD socket | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| **Battery & charger** | | | | | | |
| Battery capacity | 4,590mAh | 4,590mAh | 50Wh | 75Wh | 70Wh | 70Wh |
| Charger wattage | 65W | 65W | 65W | 65W | 65W | 65W |
| Charger weight | 332g | 323g | 330g | 335g | 367g | 367g |
| Charging options | USB-C | USB-C | USB-C | USB-C | USB-C | USB-C |
| **Webcam** | | | | | | |
| Max video resolution | 1440p | 1080p | 1080p | 1440p | 1080p | 1080p |
| Facial login | ✗ | ✗ | ✗ | ✓ | ✓ | ✓ |
| Privacy cover | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Ports & connectivity** | | | | | | |
| Wireless standard | Wi-Fi 6E | Wi-Fi 6E | Wi-Fi 6E | Wi-Fi 7 | Wi-Fi 7 | Wi-Fi 6E |
| Bluetooth standard | Bluetooth 5.3 | Bluetooth 5.3 | Bluetooth 5.2 | Bluetooth 5.4 | Bluetooth 5.4 | Bluetooth 5.3 |
| RJ45 | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| HDMI | 1.4 | 1.4 | 1.4 | ✗ | 2.1 | 2.1 |
| USB-C | 2 x USB 3.2 Gen 2 | 2 x USB 3.2 Gen 2 | 1 x USB 3.2 Gen 1 | 2 x USB 4 | 2 x USB 4 | 2 x USB 4 |
| USB-A | 2 x USB 3.2 Gen 1 | 2 x USB 3.2 Gen 1 | 2 x USB 3.2 Gen 1 | 2 x USB 3.2 Gen 1 | 2 x USB 3.2 Gen 1 | 2 x USB 3.2 Gen 2 |
| MicroSD card reader | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| 3.5mm audio jack | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| **Keyboard & touchpad** | | | | | | |
| Backlit keyboard | ✗ | ✗ | ✗ | ✓ | ✓ | ✓ |
| Touchpad dimensions (WH) | 126 x 83mm | 126 x 83mm | 104 x 60mm | 125 x 78mm | 129 x 84mm | 127 x 80mm |
| Fingerprint reader | ✗ | ✗ | ✗ | ✓ | ✗ | ✗ |

[1] Prices correct at time of going to press but are subject to change. [2] Based on reader feedback in *PC Pro* Excellence Awards 2024. See issue 363, p28 for full details. N/A means not enough feedback from readers for reliable results. [3] P = Performance cores, E = Efficiency cores

| | | RECOMMENDED | LABS WINNER | | RECOMMENDED |
|---|---|---|---|---|---|
| **Dell 14 Plus** | **HP Chromebook Plus x360** | **HP OmniBook Ultra 14** | **Lenovo Yoga Slim 7x** | **MSI Modern 15 F1MG** | **Samsung Galaxy Chromebook Plus** |
| ★★★★☆ | ★★★☆☆ | ★★★★☆ | ★★★★★ | ★★★☆☆ | ★★★★☆ |
| £833 (£999 inc VAT) | £249 (£299 inc VAT) | £833 (£999 inc VAT) | £749 (£899 inc VAT) | £583 (£699 inc VAT) | £416 (£499 inc VAT) |
| £833 (£999 inc VAT) | £316 (£379 inc VAT) | £1,249 (£1,499 inc VAT) | £749 (£899 inc VAT) | £583 (£699 inc VAT) | £499 (£599 inc VAT) |
| dell.com | hp.com | hp.com | currys.co.uk | currys.co.uk | samsung.com |
| DB14250 | 14b-cd0000na | 14d-fd0002na | 83EDCT01WWGB2 | 654476 (Currys code) | XE550XGA-KC2UK |
| 314 x 226 x 17mm | 323 x 210 x 20.4mm | 315 x 228 x 16.4mm | 325 x 225 x 12.9mm | 359 x 236 x 19.9mm | 355 x 226 x 8.9mm |
| 1.6kg | 1.4kg | 1.6kg | 1.3kg | 1.7kg | 1.2kg |
| 1yr RTB | 1yr RTB | 1yr RTB | 1yr RTB | 1yr RTB | 1yr RTB |
| 79%/85% | 77%/84% | 77%/84% | 77%/85% | 80%/79% | 80%/88% |
| Intel Core Ultra 7 258V | Intel Core i3-N305 | AMD Ryzen AI 9 365 | Qualcomm Snapdragon X Elite X1E-78-100 | Intel Core 7 150U | Intel Core 5 120U |
| 8 (4P 4E) | 8 | 10 (4 x Zen 5, 6 x Zen 5c) | 12 | 10 (2P 8E) | 6 (2P 8E) |
| 8 | 8 | 20 | 12 | 12 | 12 |
| 4.8GHz | 3.8GHz | 5GHz | 3.4GHz | 5.4GHz | 5GHz |
| 32GB LPDDR5X | 8GB LPDDR5 | 32GB LPDDR5X | 16GB LPDDR5X | 16GB DDR4 | 8GB LPDDR5X |
| ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| Intel Arc 140V | Intel UHD Graphics | AMD Radeon 880M | Qualcomm Adreno X1-85 | Intel Graphics | Intel Graphics |
| 14in IPS | 14in IPS | 14in IPS | 14.5in OLED | 15.6in IPS | 15.6 AMOLED |
| 2,560 x 1,600 | 1,920 x 1,080 | 2,240 x 1,400 | 2,944 x 1,840 | 1,920 x 1,080 | 1,920 x 1,080 |
| 216ppi | 157ppi | 189ppi | 239ppi | 141ppi | 141ppi |
| 90Hz | 60Hz | 60Hz | 90Hz | 60Hz | 60Hz |
| ✗ | ✓ | ✗ | ✗ | ✗ | ✗ |
| Matte | Matte | Matte | Gloss | Matte | Matte |
| SC Hynix PC 901 | Samsung KLUEG4RHGB-B0E1 | SK Hynix PC801 | Micron MTFDKCD1T0TGE-1BK1AABLA | Samsung MZVL81T0HELB-00BTW | Samsung KLUEG8UHDC-B0E1 |
| NVMe PCIe Gen 4 | UFS 3.1 | NVMe PCIe Gen 4 | NVMe PCIe Gen 4 | NVMe PCIe Gen 4 | UFS 3.1 |
| 1TB | 256GB | 1TB | 1TB | 1TB | 256GB |
| ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| 64Wh | 47Wh | 68Wh | 70Wh | 47Wh | 4,340mAh |
| 65W | 45W | 65W | 65W | 65W | 45W |
| 317g | 315g | 315g | 350g | 294g | 159g |
| USB-C | USB-C | USB-C | USB-C | Proprietary adaptor | USB-C |
| 1080p | 1080p | 1440p | 1080p | 720p | 1080p |
| ✗ | ✗ | ✓ | ✓ | ✗ | ✗ |
| ✓ | ✓ | ✓ | ✗ | ✓ | ✓ |
| Wi-Fi 7 | Wi-Fi 6 | Wi-Fi 7 | Wi-Fi 7 | Wi-Fi 6E | Wi-Fi 6E |
| Bluetooth 5.4 | Bluetooth 5.3 | Bluetooth 5.4 | Bluetooth 5.4 | Bluetooth 5.3 | Bluetooth 5.3 |
| ✗ | ✗ | ✗ | ✗ | 1GbE | ✗ |
| 2.1 | ✗ | ✗ | ✗ | 1.4 | Not stated |
| 1 x USB 3.2 Gen 2, 1 x Thunderbolt 4 | 2 x USB 3.2 Gen 1 | 2 x USB 4 | 3x USB 4 | 1 x USB 3.2 Gen 2 | 2 x USB 3.2 Gen 2 |
| 1 x USB 3.2 Gen 1 | 1 x USB 3.2 Gen 1 | 1 x USB 3.2 Gen 2 | ✗ | 3 x USB 3.2 Gen 1 | 1 x USB 3.2 Gen 1 |
| ✗ | ✗ | ✗ | ✗ | ✓ | ✓ |
| ✓ | ✓ | ✓ | ✗ | ✓ | ✓ |
| ✓ | ✗ | ✓ | ✓ | ✓ | ✓ |
| 114 x 80mm | 119 x 68mm | 125 x 82mm | 135 x 81mm | 120 x 74mm | 130 x 89mm |
| ✗ | ✗ | ✓ | ✗ | ✗ | ✗ |

# Buyer's guide: embrace the everyday

**Much as manufacturers would love you to buy their most expensive laptops, there are some great choices for under a grand – if you follow our advice**

We all like value for money, and when it comes to laptops that often means exploring the budget and mid-range options: these markets are both huge and incredibly competitive. However, build quality, screen quality and the overall spec can vary massively between models, and the amount of money you spend doesn't necessarily always match the quality of the resulting laptop.

In this guide, we aim to provide a structured approach to narrow your options down. This means that you should end up with a smaller pool of laptops to choose from, but we also hope that you can spot the times when spending an extra £50, £100, £150 will make a difference – and where you're simply wasting your money.

**RIGHT** Opt for a 13in or 14in model if you're always on the move

## STEP 1: CHOOSE YOUR OS AND ARCHITECTURE

In the past we'd have urged you to think about the size and form factor first, but right now we'd start with the operating system and systems architecture. Why? Because if you're choosing between Chromebooks, ordinary Windows laptops and some Copilot+ PCs, this choice will have a big impact on how you use your laptop.

Chromebooks can be brilliant, simple and effective PCs. The OS has matured, looks great and needs minimal maintenance. Chromebooks also start up almost instantly and your usage is rarely spoilt by intrusive ads or lengthy updates. However, you're restricted to using web apps and Android apps, some of which may not have been designed for laptop use.

This really isn't a problem if you work in Gmail and Google's Workspace office apps, and you can even use Microsoft 365 Web apps for Office compatibility. It is, however, a problem if you want to use Microsoft's desktop Office apps, the full range of Adobe's creative apps or other mainstream Windows applications.

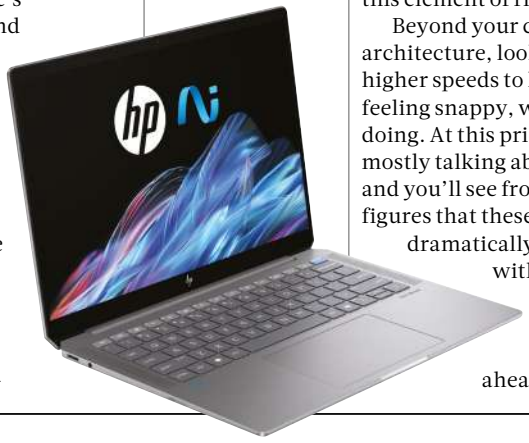
Copilot+ PCs that use the ARM64 architecture – that is, chips from the Qualcomm Snapdragon family – share some of the same issues. Microsoft, Adobe and many other software vendors have released ARM64 versions of their biggest apps, and Microsoft's Prism emulation layer does a fantastic job of running many others. That said, there are still some apps that won't run on a Windows on Arm device, and many PC games either don't run or run slowly. Some peripherals still ship without Arm-compatible drivers.

**In the past we'd have urged you to think about the size and form factor first, but now we'd start with the OS and systems architecture**

We suspect the situation will improve with time as Snapdragon X and other Arm CPUs build up a larger user base. All the same, if you use unusual applications or just want to play it safe, a laptop based on Intel or AMD technology comes without this element of risk.

Beyond your choice of architecture, look for more cores and higher speeds to keep your laptop feeling snappy, whatever you're doing. At this price point you're mostly talking about integrated GPUs, and you'll see from the benchmark figures that these can vary dramatically in performance, with AMD's Ryzen AI 9 and Intel's Core Ultra 200 series processors surging ahead of the pack.

**BELOW** Laptops based on Ryzen AI 9 chips, such as HP's OmniBook Ultra 14, offer plenty of power



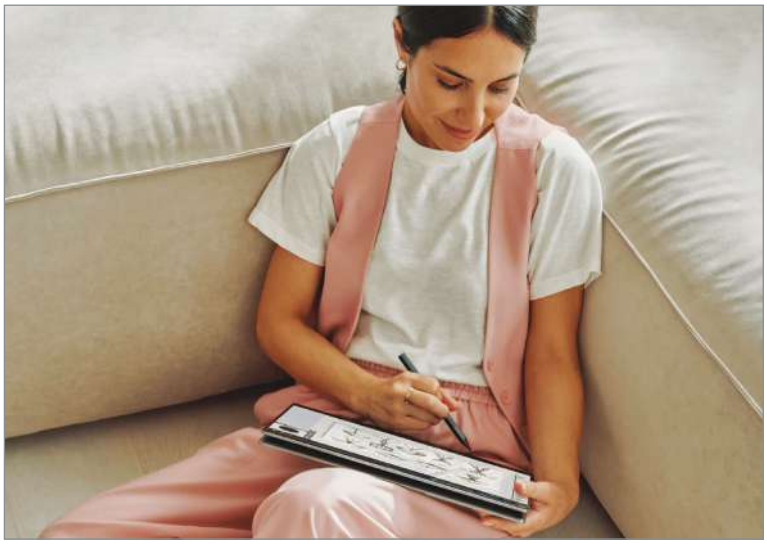
Neural Processing Units (NPUs) are slowly becoming useful, but are still criminally under-supported in Windows and many mainstream apps. You're likely to get one whether you want it or not on a modern Windows laptop, but don't be surprised if it doesn't rock your world right now. See p85 for more on Copilot+ PCs, which require powerful NPUs.

## STEP 2: PICK YOUR FORM FACTOR

Basically, this comes down to where and how you want to use your laptop. If you're mostly working at a desk or kitchen table, going big with a 15in to 16in laptop will usually get you a bigger and more comfortable keyboard, more connectivity and less eyestrain from staring all day at a small screen.

If you're constantly on the move, a smaller 13in or 14in device will be lighter to carry and easier to use in sometimes cramped conditions. Squarer screens with higher QHD+ resolutions can feel bigger than they actually are, and some compact laptops manage to find an effective balance between portability and all-day usability.

Design is important, both in the sense that thoughtful touches can make your laptop easier to live with, and in the sense that most of us want a laptop that actually looks good.



Don't neglect solid materials and good build quality, however. A tough construction will keep your laptop working hard for longer, and sometimes strong plastics can beat thin, cheap aluminium when it comes to holding up over years of use.

## STEP 3: SCREEN AND KEYBOARD

There are two things on a laptop that you can rarely upgrade and that will have a huge impact on your everyday use. Top of that two-strong list: the screen. If it's dim and foggy or if colours look washed out and dull, it's going to affect everything from browsing the web to image-editing and streaming video.

Choosing an OLED screen near enough guarantees excellent colour coverage, so if you have the budget for such a laptop then it's worth the expense (although it will have an impact on battery life). If not, we recommend choosing a laptop with an IPS screen that can reproduce most of the colours (70% or more) in the DCI-P3 space. If you're not fussed by punchy images, at least look for coverage of 80% or more in the sRGB colour gamut. We print the results of all our display testing on p95, but sometimes you will only have manufacturer's claims to go for. If they don't say anything about DCI-P3 or sRGB coverage then be wary. Sometimes you will only see a claim for NTSC coverage, and if it says less than 50% then expect washed-out images.

**ABOVE A larger screen is preferable if you'll mainly be using your laptop at home**

As for the keyboard, its importance grows if you spend a lot of your average day typing, but even casual users will find floppy keys and cramped or unfamiliar layouts a serious irritation. You can fix a bad touchpad by hooking up a mouse, but do you really want to reach for a Bluetooth keyboard every time you use your laptop?

**BELOW Some laptops sacrifice connectivity for slimness**

## STEP 4: SPEC UP YOUR RAM AND STORAGE

Over the past few years, more demanding applications and the spiralling memory usage of web pages have seen Windows laptops shifting from 8GB of RAM as a baseline standard to a more realistic 16GB. We would no longer recommend a laptop that comes with less than this. While 32GB is great if you can afford it, it's not a necessity for running mainstream apps.

Chrome OS is less memory-hungry, and you can still get away with the 8GB mandated in Google's Chromebook Plus requirements. Don't go lower than that, however, as even web-based apps need RAM.

Chromebooks also require less storage, given that most of your documents and photos will be stored and processed in the cloud. However, having 256GB or more will give you scope to install more Android apps and work on video projects or images locally without the latency of an internet connection. With Windows laptops, you really need all the storage you can get. In 2025, 256GB is a joke; look for 512GB as a minimum and 1TB as a sensible upgrade.

## STEP 5: CONNECTIVITY OPTIONS

Some manufacturers are cutting back on connectivity, either because they feel a couple of USB-C ports is enough or because they can't cram more into their thin and light chassis. This isn't a problem if you rarely plug in external peripherals, or perhaps you own a docking monitor that packs its own USB-A ports. When at your desk, that means you only need to connect one USB-C cable and you instantly have access to your monitor's ports.

You can also plug a port replicator or docking station into one of your laptop's USB-C ports, which can be a great way to hook up to a monitor, projector or external drive. Even so, it makes sense to have the ports you need onboard. We miss USB-A ports in particular.

In terms of speed, look out for USB-A 3.2 Gen 2, USB 4 and Thunderbolt 4. The former provides reasonable 10Gbits/sec bandwidth, much appreciated when transferring larger files, while the latter two are at least four times faster and make them a viable choice for external storage – to store media files or games, for instance, when back at base.

## STEP 6: CONSIDER YOUR BATTERY LIFE

There's no need to have a laptop plugged into the mains these days. Most can make it through a working day without a recharge and get a useful top-up within an hour or so. The latest Snapdragon X, AMD Ryzen AI and Intel Core Ultra processors are more energy-efficient, and combined with 60Wh and larger batteries will see you through a full day's work without a struggle. However, the 16 to 20 hours you see in our battery life tests will dip with more demanding apps or if you pump up the screen brightness. If mobility is a priority, check our battery rundown test results on p95 before you buy.

## The Apple alternative

We haven't included Apple in this group test, despite the fact that it does indeed sell a laptop that meets our criteria: the cheapest 13in MacBook Air costs £999. We provided a full review of the MacBook Air three months ago (*see issue 368, p54*) and it is a fantastic laptop – Apple doesn't skimp on the quality of the 13.6in panel, the 10-core M4 processor is a great choice for multitasking, and battery life is strong at around 15 hours of light use.

The sacrifice comes in the size of the SSD, which at 256GB is extremely limiting even if you offload much of your storage to cloud-based services. Upgrading to 512GB costs £200, while 1TB (increasingly standard in even budget Windows laptops) costs £400. Ultimately we would recommend the vast majority of people to upgrade to 512GB, which pushes it into premium territory.

**ABOVE MacBooks are a fine choice even if you're on a budget**

If you're on a limited budget but are keen on buying a MacBook, then see what you can pick up from reputable refurb sellers such as Back Market (**backmarket.co.uk**), which won a *PC Pro* Excellence award last year. At the time of writing, it was selling an M2 Pro 14in MacBook Pro with a 512GB SSD for £999.

# ACER SWIFT 14 AI

## A stylish, sleek all-rounder that makes an awful lot of sense if you can find it for under £800

**SCORE** ★★★★☆

**PRICE** £583 (£699 inc VAT)
**from currys.co.uk**

When it launched last year, the Acer Swift 14 AI had the makings of a compelling Copilot+ PC but for one thing: its price. Manufacturers could get away with a £1,199 inc VAT asking price on a top-spec model, but not on a mid-range performer using Qualcomm's lower-end Snapdragon X Plus chip. Luckily, it's a different story now that the Swift 14 AI is widely available for around £699 to £799. In fact, at that price it's an absolute bargain.

For a start, you're buying a premium-feel aluminium body in an understated dark metallic shade. It looks great and feels robust, with a 323 x 226mm desktop footprint and a weight of only 1.4kg. It's slim, too, measuring under 15mm at its thickest point. With two USB-A 3.2 Gen 1 ports and a pair of speedy USB-C 4 ports, you've got a decent level of wired connectivity. There's no physical Ethernet port, of course, but it's great to see Wi-Fi 7 and Bluetooth 5.4.

The keyboard is a real step up from the Acer Chromebooks in this Labs, which is as we would expect: Acer positions the Swift 14 AI near the top of its range. The layout isn't perfect; we'd like to see larger Shift and Ctrl keys on the left-hand side, and the power button/fingerprint reader in the top-right corner is confusing if you rely heavily on the Delete key. Still, the action is clean and fast with just enough travel, and it doesn't take long to reach your normal typing speed.

While the touchpad has an unnecessary gimmick – a glowing sigil symbol that illuminates when the laptop's AI hardware is active – it doesn't make it any less smooth, accurate or responsive. You can get some serious work done without reaching for a mouse.

Acer has opted for a 14.5in IPS display with a 16:10 aspect ratio and 2,560 x 1,600 resolution. Bearing in mind this laptop's price, it's excellent. It hits maximum brightness levels of 374cd/m² while keeping black levels fairly low at 0.24cd/m², resulting in a contrast of 1,576:1. It covers 100% of the sRGB colour gamut and 77% of DCI-P3, which translates into strong (but not the most punchy) colours. Colour accuracy is also strong with an average Delta E of 1.19, while the 120Hz refresh rate makes scrolling smooth.

Overall, that adds up to a great screen for mainstream office use, and it will stretch to photo and video editing so long as you aren't a professional. The same goes for the audio, which is mostly clear and punchy, though with a slightly harsh mid-range that takes over as you push up the volume. Meanwhile, the QHD webcam is another premium feature, providing clear, well-exposed video that's perfect for meetings and online chats.

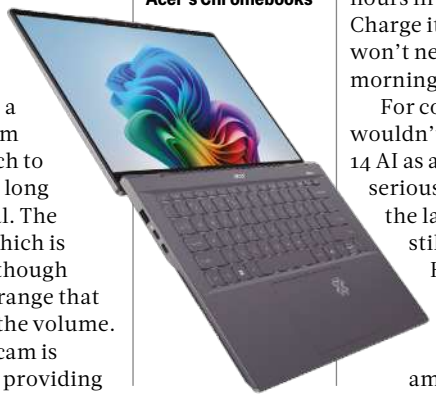
**ABOVE** **The Swift 14 AI is a stylish laptop with a superb display and great battery life**

**Acer has opted for a 14.5in IPS display with a 2,560 x 1,600 resolution. Bearing in mind this laptop's price, it's excellent**

As we mentioned, the Swift 14 AI is based on one of Qualcomm's entry-level Snapdragon X Plus chips rather than its high-performance Snapdragon X Elite CPUs, but here we're talking about the 10-core Snapdragon X Plus X1P-64-100 rather than the basic 8-core models. This gives the Swift 14 AI an edge in many of our benchmarks, especially in complex, multithreaded workloads. It even delivers solid results in the 3D benchmarks, where other Snapdragon X Plus laptops struggle, but as ever we're not going to recommend a Snapdragon-powered laptop for gaming.

**LEFT** **The premium aluminium body belies the laptop's low price**

**BELOW** **The keyboard is a real step up from Acer's Chromebooks**



Where it absolutely wins is for battery life, which is good enough to get you through a full day and more: the Swift 14 AI lasted just over 15 hours in our video-rundown test. Charge it up in the morning and it won't need a recharge until the next morning – or even the next afternoon.

For compatibility reasons we wouldn't recommend the Acer Swift 14 AI as a gaming laptop or even as a serious creative tool. That's where the latest Intel and AMD CPUs still have the advantage. However, if you're looking for a strong, mid-range all-rounder, the Swift 14 AI delivers a tremendous amount at this price.

**JARGON BUSTER** **USB ports** There are two main types of USB port currently in use: USB-A and USB-C. USB-A is the older, rectangular format often used by printers, for example. It can only deliver data and a small amount of power. USB-C can often connect to a monitor and can deliver enough power to feed a typical laptop.

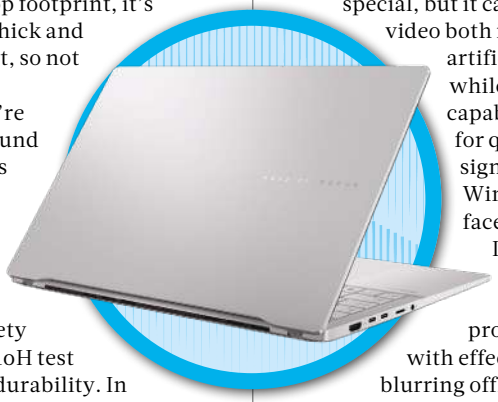
# ASUS VIVOBOOK S15

## Not the slimmest nor the sexiest, but an excellent OLED screen and all-round usability lift it above rivals

**SCORE** ★★★★☆
**PRICE** £583 (£699 inc VAT)
**from** currys.co.uk

While it's easy to be enthralled by the latest ultra-slim, ultra-light laptops, the Vivobook S15 is a great example of the advantages a larger model brings. Not only does it have a big, 15.6in OLED screen that's perfect for either productivity or entertainment, it has a more spacious keyboard, a numeric keypad and more connectivity than rival Copilot+ PCs. If it's not the most exciting device on test, it's easily one of the most usable and versatile.

It's also one of the best built, with a solid aluminium shell for protection. Despite its large 353 x 227mm desktop footprint, it's only 14.7mm thick and 1.4kg in weight, so not too much of a handful if you're carrying it around all day. There's no give in the body and barely any in the lid, and Asus claims it meets a variety of MIL-STD-810H test standards for durability. In short, it's shiny and it's tough.



**LEFT** The solid aluminium shell provides protection

Asus packs in the ports and sockets, too, with twin pairs of USB-C 4 and USB-A 3.2 Gen 1 ports, an HDMI 2.1 output, microSD card reader and a 3.5mm audio jack. As is often the case, both USB-C ports sit on the left-hand side, which is bad news if your nearest mains socket is on the right, but you have all the connectivity you need onboard, bar Ethernet, without plugging in a dock. As far as networking goes, you're reliant on the built-in tri-band Wi-Fi 7 chip.

Not everyone will like the look of the Vivobook's large, flat-topped keys, or the undersized left Shift and Ctrl keys. However, neither turns out to be an impediment in actual use, and the action is speedy and tactile. Spreadsheet warriors will appreciate the separate numeric pad. Meanwhile, the touchpad is a good match for the screen size, at 129 x 85mm, and responsive to every swipe, slide and tap.

The 1080p webcam is nothing special, but it captures decent video both in natural and artificial lighting, while infrared capabilities allow for quick and easy sign-in using Windows Hello face recognition. It benefits from the NPU built into the processor, too, with effects such as blurring offloaded here.

Asus deserves full credit for the audio, which is warm and well rounded provided you keep the volume below the halfway mark.

But the screen is the star, with a generous 2,880 x 1,620 resolution making the most of the 15.6in diagonal to give you plenty of space for multitasking or entertainment after hours. We measured SDR brightness levels at over 400cd/m², while it covers 99% of the sRGB colour gamut and 72% of DCI-P3. Other OLED panels go further still in terms of coverage, but let's remember this laptop's price – and colour accuracy is strong, with an average Delta E of 1.59. The Vivobook S15 could handle professional image-editing, video and design applications, provided your favourites run well under ARM64.

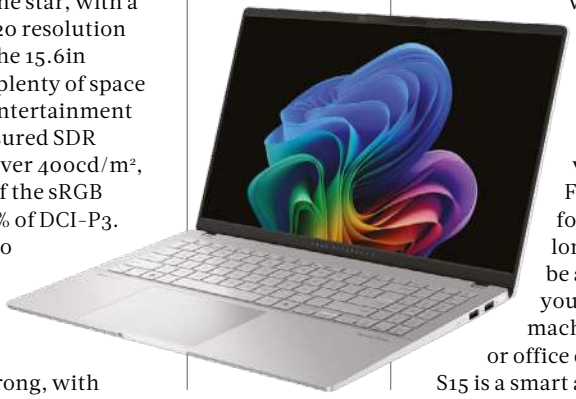
**ABOVE** The 15.6in OLED screen is ideal for productivity and entertainment alike

**The screen is the star, with a generous 2,880 x 1,620 resolution making the most of the 15.6in diagonal to give you plenty of space**

This might be a sticking point for some people, especially when the Vivobook S15 we're testing uses the weaker eight-core Snapdragon X Plus X1P-42-100 processor rather than a Snapdragon X Elite. This puts it behind the leaders in more demanding, multithreaded benchmarks, and also in 3DMark's Wild Life Extreme and Nomad Lite tests. However, there's plenty of performance here for mainstream productivity and creative apps, while those who need a more powerful GPU for AI or gaming should look to the more capable (and more expensive) AMD Ryzen AI 9 or Intel Core Ultra CPUs instead.

Bigger laptops rarely win when it comes to battery life, but the Vivobook should still get you through a long working day, surviving 13hrs 23mins of our video-rundown test. For some, a lighter form factor and a longer battery life will be a priority, but if you're looking for a machine to handle home or office duties, the Vivobook S15 is a smart and practical choice.

**BELOW** A larger footprint allows space for a separate number pad and big touchpad



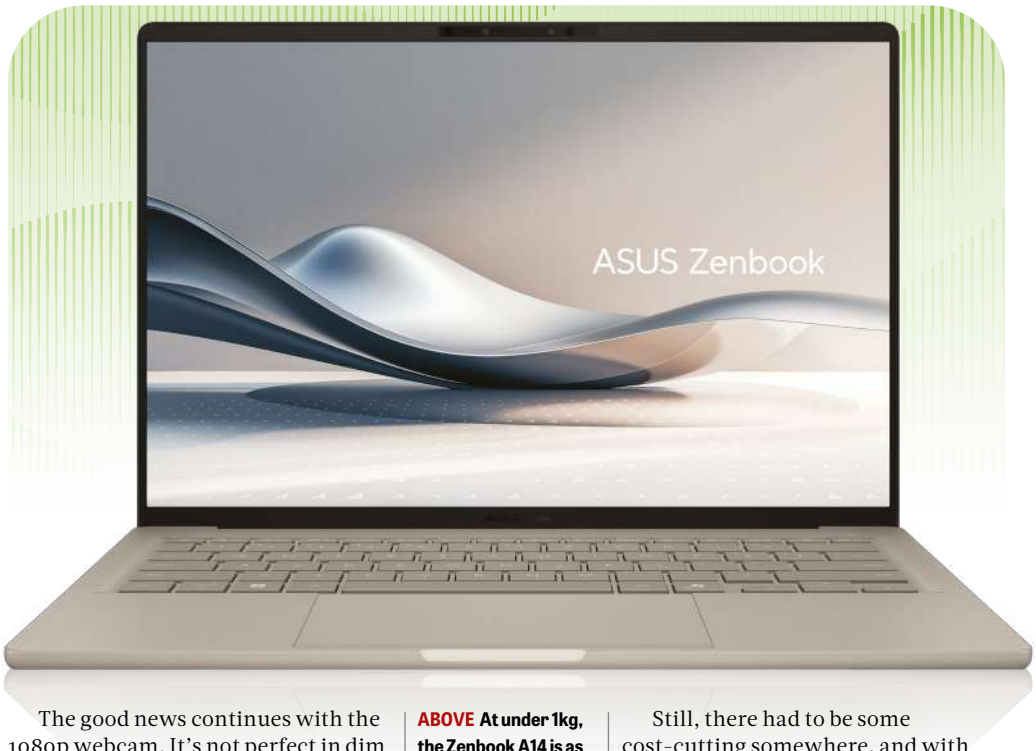
JARGON BUSTER **USB speeds** The oldest USB rating is USB 2.0, which peaks at 480Mbits/sec. USB 3.2 Gen 1 supports a peak rate of 5Gbits/sec, USB 3.2 Gen 2 maxes out at 10Gbits/sec and USB 3.2 Gen 2x2 up to 20Gbits/sec. USB 4 supports up to 80Gbits/sec, while Thunderbolt 4 ports go up to 40Gbits/sec.

# ASUS ZENBOOK A14

## Not particularly powerful, but more than makes up for this with its gorgeous, thin and light design

**SCORE** ★★★★☆

**PRICE** £750 (£900 inc VAT)
**from** johnlewis.com




The Asus Zenbook A14 is proof that you don't need to spend a fortune for a stylish thin and light laptop. In fact, signs of having been built to a budget are few and far between. Its shell is made from Ceraluminium, which is what Asus calls aluminium treated with a sort of matte ceramic coating. It's very compact at 317 x 214mm and a mere 15.9mm thick. And at just under 1kg, it's ludicrously light.

The Ceraluminium is wear-, scratch- and smudge-resistant, and the construction as a whole feels solid and surprisingly tough. Despite being so slim, the Zenbook still crams in two USB-C 4 ports, an HDMI 2.1 output and a 3.5mm audio jack on the left-hand side, with a single USB-A 3.2 Gen 2 port on the right. You'll need one Type-C port for occasional charging, but that's not a major issue with this laptop. And while the lack of Wi-Fi 7 is slightly disappointing when it's a feature of so many rivals, it's unlikely to be a deal breaker when so many homes and offices still rely on Wi-Fi 6, let alone 6E.

The Zenbook's keyboard has some negative points, including a soft action, titchy left Shift and Ctrl keys and a row of tiny function keys. But it also has its positive points. There's a satisfying click on actuation, and the feel is very consistent across the width. The touchpad makes the most of the available space, stretching from the bottom of the keyboard almost to the laptop's edge, and has a premium glassy feel and sensitive tracking. For such a compact machine, the A14 is very usable.

The good news continues with the 1080p webcam. It's not perfect in dim artificial lighting, where it falters on colour and exposure, but in daylight or brightly lit conditions it captures detailed and polished-looking video, especially with a little assistance from Windows Studio Effects.

The audio can sound thin and lacking in body, but there's slightly more bass than you'll find on similarly lightweight laptops, and the speakers can go surprisingly loud without becoming painful to listen to.

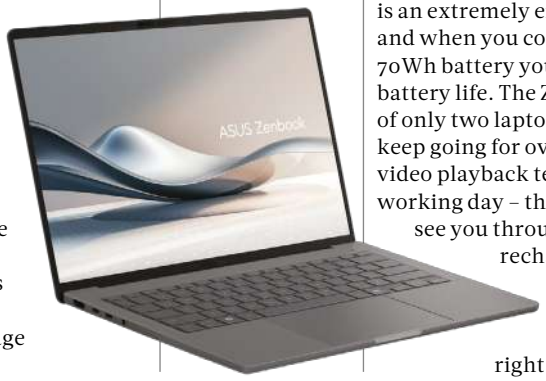
We've no serious caveats about the screen. True, the 1,920 x 1,200 resolution isn't exactly class-leading when other 14in devices are packing QHD+ screens, but the OLED panel gives you the usual dark blacks and dazzling contrast. It also reaches SDR brightness levels of over 400cd/m², which is great for an OLED panel. It even covers 99% of DCI-P3 colour gamut. It's the kind of display that seems made for editing photos or streaming video, and its colour accuracy is up to the mark, with an average Delta E of only 1.48.

**ABOVE** At under 1kg, the Zenbook A14 is as portable as they come

**The X1-26-100 is an extremely energy-efficient chip, and when you combine this with a 70Wh battery you get extraordinary battery life**

**LEFT** Connectivity is superb for such a slim, lightweight laptop

**BELOW** The bright OLED display is perfect for editing photos and videos




Still, there had to be some cost-cutting somewhere, and with the Zenbook A14 it's in the core spec. Where other Copilot+ PCs on test pack in faster versions of the Snapdragon X Plus processor, the A14 uses the entry level Snapdragon X1-26-100, with eight cores running at up to 3GHz and a 1.7 TFLOPs Adreno X1-45 GPU. Compare that to the Snapdragon Plus X1P-64-100 in the Acer Swift 14 AI, which has ten cores at 3.4GHz and a 3.8 TFLOPs Adreno X1-85 GPU. This Zenbook A14's slower chip by no means cripples performance, but it holds it back in GPU-intensive tests. The laptop feels slick and speedy when handling mainstream browsing or office tasks, but isn't a machine for even casual gaming.

The upside, however, is that all current Snapdragon chips in Copilot+ PCs include the same NPU, so there's no sacrifice there. Plus, the X1-26-100 is an extremely energy-efficient chip, and when you combine this with a 70Wh battery you get extraordinary battery life. The Zenbook A14 is one of only two laptops in this Labs to keep going for over 20 hours in our video playback test, Forget one working day – this laptop might even see you through two without a recharge. If mobility is your priority, that might be enough to make the A14 the right machine for you.

JARGON BUSTER **Screen resolutions** Full HD panels include 1,920 x 1,080 pixels, often shortened to 1080p. That's a 16:9 aspect ratio, but 16:10 screens are now common. If you see Full HD+ that normally means 1,920 x 1,200 (1200p). QHD is 2,560 x 1,440, while QHD+ is normally 2,560 x 1,600. 4K, or Ultra HD, is 3,840 x 2,160 pixels.

# Copilot+ PCs: the state of play in mid-2025

**If you recall Recall, then you'll know its launch was far from smooth. But good things are finally happening, with Copilot+ PCs slowly gaining new talents**

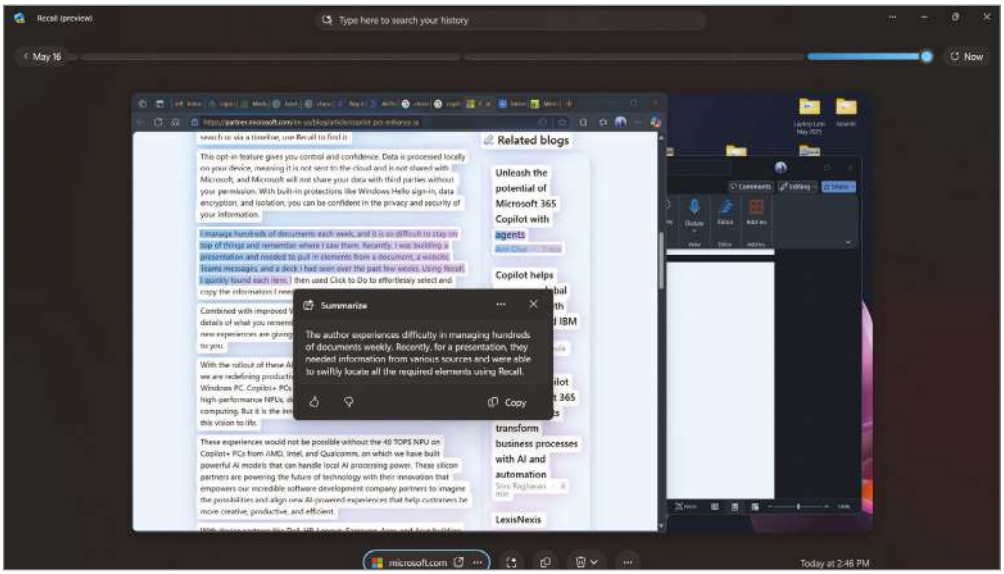
Microsoft's Copilot+ PCs didn't have the smoothest launch in May 2024. There was only one big feature, and that was Recall: this promised the ability for users to jump back through time to what they were working on by searching through past activities. Say "Look for when I was creating a cat video" and Recall would understand and take you back there.

But the technology was beset by problems. Recall works by using OCR on captured screenshots while users were working, so it captured everything – including sensitive data that was then stored, at that point unencrypted, making it manna from heaven for cyberattackers. An instant backlash meant Microsoft delayed its release date, promising many changes in response to criticism.

This left the first tranche of Copilot+ PCs with limited features that ran locally on their fancy new computers. People could play with Windows Paint's Cocreator AI-enhanced illustration tool, or restyle photos in Photos, but both felt like gimmicks, something to keep kids entertained for five minutes.

Live Captions, real-time translation for videos, were useful for a subset of users, while enhanced Windows Studio Effects not only offloaded sophisticated blurring effects onto the NPU but added extra polish via creative filters and fake portrait lighting. All "nice to have" features, but not life-changing.

Microsoft needed to offer more, and that's what it has attempted to do with the recall of Recall and "Wave 2" Copilot+ PC features.


Recall (preview)
Type here to search your history
May 16
Now
Related blogs
Unleash the potential of Microsoft 365 Copilot with agents
Copilot helps
Summarize
The author experiences difficulty in managing hundreds of documents weekly. Recently, for a presentation, they needed information from various sources and were able to swiftly locate all the required elements using Recall.
Copy
transform business processes with AI and automation
LexisNexis
Today at 2:46 PM

**ABOVE** **Recall has finally arrived in preview, but problems unfortunately remain**

## Recall lives again

The good news is that a much-improved version of Recall has arrived. It has now been rolled out to most Copilot+ users, albeit in a preview form, with some of the security concerns met by an additional Windows Hello security check before you're allowed to scan or search through your previous activity. Once that's passed, you can scrub backwards and forwards through the screenshots Recall has been taking, then launch files, websites and applications direct from the Recall tool, or use the new Click to Do feature to interact in some context-sensitive way with the visible content. For instance, you might summarise key points from selected text, ask Copilot to rewrite a paragraph or perform a visual search of an object in an image using Bing.

**The good news is that a much-improved version of Recall has arrived. It has now been rolled out to most Copilot+ users**

**BELOW** **Wave 2 brings context-sensitive actions in "Click to Do"**

Recall is already quite handy if you struggle to remember what website you were looking at when you found something useful or interesting, or you just want to quickly open up a document you were looking at earlier in the week. Its security isn't watertight yet, though: it recorded screenshots of an internet banking screen with sensitive login information visible, even though it's not supposed to do so.

## Wave 2 features

Wave 2 Copilot+ PC features won't sweep you off your feet, but they're useful. First up is "Click to Do", which uses AI tech to pick out useful actions based on what you're doing at that moment. Press Win+left click and it will use the NPU to analyse the screen and work out if it should copy text, launch an editing app, quickly edit an image or, perhaps, perform a web search. We like that it avoids your data being uploaded to the cloud and that it can already handle a wide – and growing – range of tasks.

Meanwhile, an enhanced Windows Search can now find documents or files using natural language processing so that, rather than search by the name, you can search for people or subjects mentioned, or just by subject matter. It's even supposed to find key Windows settings from your own descriptions, though at the time of writing this just pulled up helpful Microsoft Support articles explaining how to change the required settings yourself.

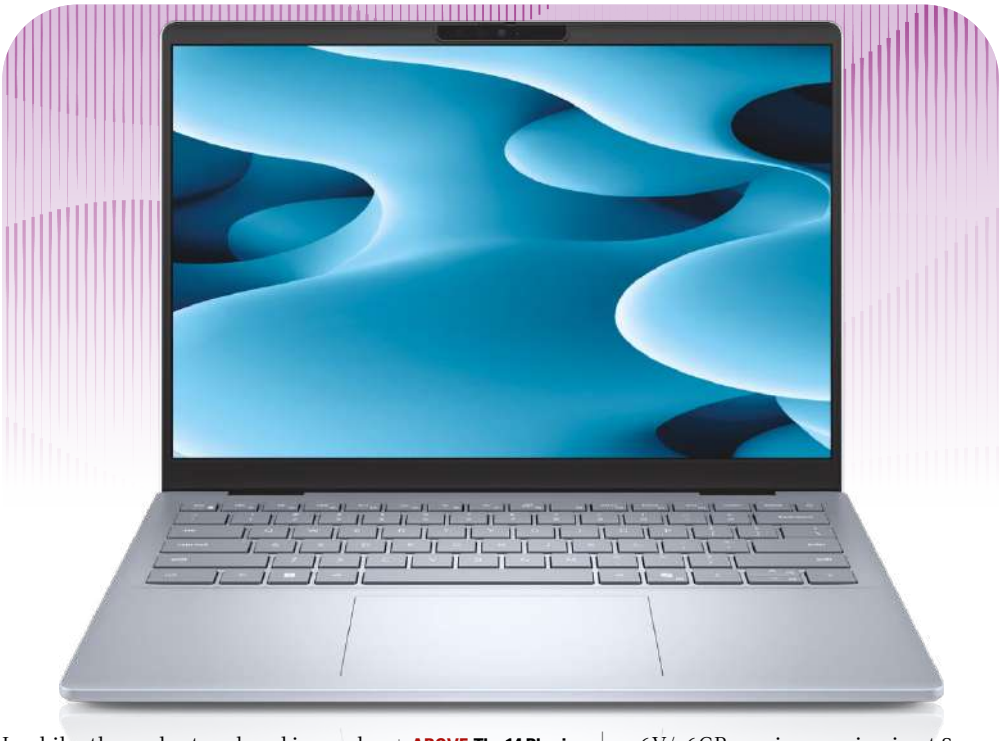
This is typical of the way in which Copilot+ PC still feels like a work in progress – an initiative that's looking for a killer app, rather than a fully realised hardware/software AI ecosystem. It is improving, though, with features that feel more like serious enhancements, and less like superficial features designed to justify the purchase of an AI-ready PC.

# DELL 14 PLUS

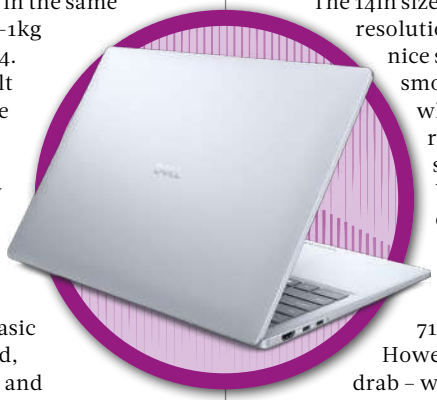
## Impressive Core Ultra 7 performance, though you'll find better screens elsewhere

**SCORE** ★★★★☆

**PRICE** From £833 (£999 inc VAT) from dell.com



Dell pitches the 14 Plus as a lightweight AI laptop for small businesses and creatives, and in most respects it's right on the mark. With a choice of 200-series Intel Core Ultra 7 and Ultra 9 CPUs, it has the NPU performance for Copilot+ AI applications, plus the integrated Intel Arc graphics to run local AI apps and accelerate some video and design tools, or even handle basic gaming. The 14in screen might not be OLED, but it has the high resolution and colour performance less demanding creative users will require, and at 1.55kg it's reasonably light, though not in the same league as the sub-1kg Asus Zenbook A14.



It's a well-built laptop, even if the design is rather pedestrian. It's fashioned mostly from silver plastic but with a matching aluminium lid. Connectivity is basic but perfectly solid, with USB Type-C and Thunderbolt 4 ports plus an HDMI 2.1 output, a 3.5mm audio socket and a single USB-A 3.2 Gen 1 port. The top right key on the keyboard doubles as a fingerprint reader and a power key, enabling trouble-free and speedy signing in. With Wi-Fi 7 and Bluetooth 5.4 on board, you have everything you need to get to work.

We're not huge fans of the keyboard. Dell has aced the layout with good-sized keys that make touch typing easy, but spoilt things with an odd, light, clattery action that feels looser on some keys than on others. Compare it to the keyboards on the Lenovo Yoga Slim 7x or the HP OmniBook Ultra 14 and it doesn't feel as consistent or responsive. Luckily, the mylar touchpad is much better, making up for its compact size with a high level of sensitivity and accurate tracking.

The screen might be IPS rather than OLED, yet it has its strengths. The 14in size and 2,560 x 1,600 resolution give you a nice sharp image and smooth-looking text, while the 90Hz refresh rate keeps scrolling smooth. What's more, it covers 97% of the sRGB colour gamut, even if it can only manage 71% of DCI-P3. However, it's a little drab – we measured maximum brightness at 275cd/m² – and colour accuracy could be better; we measured an average Delta-E of 3.36. It's fine for productivity tasks and even lightweight image or video editing, but when you have fantastic OLED screens on the competition, this display comes across as second best.

Dell sells the Plus 14 in Core Ultra 7 and Ultra 9 configurations with 16GB or 32GB of RAM, with the entry-level Intel Core Ultra 7 256V/16GB version coming in at £999. The Core Ultra 7 258V/32GB spec we tested is faster, delivering some of the best benchmark results in this Labs.

**ABOVE** The 14 Plus is a decent laptop but fails to hit the highs of others on test

It excelled in both the Basemark 3 and WebXprt 4 browser-based benchmarks, not to mention our multitasking test. In Geekbench 6 it falls behind the AMD and Snapdragon X-powered devices, but not by much, and its single-core performance is fantastic.

**The 14in screen might not be OLED, but it has the high resolution and colour performance less demanding creative users will require**

Meanwhile, the Dell 14 Plus came second only to the HP OmniBook Ultra 14 in the 3DMark Steel Nomad Lite test, which counts for a lot: these are the only two laptops that have the widespread compatibility and 3D power to work as lightweight games machines. You'll have to lower settings and resolutions to enjoy playable frame rates, but the Dell 14 Plus will play modern games.

**LEFT** Connectivity options include USB-C and Thunderbolt 4

Battery life is slightly disappointing, with the 64Wh battery surviving 13hrs 9mins in our video-rundown test. All the same, that's going to get you through a working day and more.

Overall, this is a well-thought-out laptop that's suitable for consumers and small businesses alike. It's just not quite as strong as our award-winners where it counts.

**RIGHT** The keyboard has large, easy-to-hit keys, but it doesn't feel as responsive as the best

JARGON BUSTER **Intel Core and Core Ultra** This Dell laptop includes an Intel Core Ultra 200 series chip, which is Intel's latest mobile family and includes an NPU that meets Microsoft's Copilot+ PC baseline of 40 TOPS. Last year's 100 series chips didn't, and nor do any of its plain Intel Core chips, which are cheaper and more basic.

# HP OMNIBOOK ULTRA 14

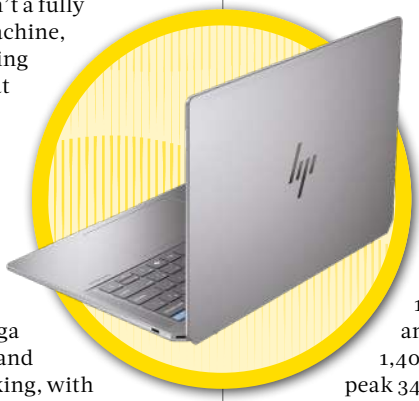
## Superb overall performance turns a decent laptop into a serious contender, but opt for the £999 version

**SCORE** ★★★★☆

**PRICE** As reviewed, £1,249 (£1,499 inc VAT) from hp.com

HP revamped its laptop branding last year, with its OmniBook range now stretching across home and business, budget and premium. We reviewed the stylish OmniBook Ultra Flip six months ago (*see issue 365, p46*), and now it's the turn of the plain OmniBook Ultra.

It costs £999 for the 16GB/512GB version, but the unit on test included 32GB of RAM and a 1TB SSD. Most importantly it packs the same AMD Ryzen AI 9 365 CPU. A quick look at our test results will tell you that it doesn't always beat the Qualcomm- and Intel-based competition, but it's close to the top of each benchmark. What's more, it steams ahead on 3D graphics performance and is the only laptop on test that will happily run most games. It isn't a fully fledged games machine, but if you're looking for one laptop that can do it all, the Ultra 14 has you covered.



While it's not as stylish or distinctive in its design as the Asus Zenbook A14 or Lenovo Yoga Slim 7x, it's slick and professional-looking, with a tough aluminium shell. It's eco-friendly, too, using 85% recycled metals and 50% post-consumer recycled plastics. It tips the scales at 1.6kg, but at just over 16mm thick it's compact enough for use on the move.

The only real compromise here is connectivity, with two USB-C 4 ports, one sneakily crammed in on the rear corner, plus a single USB-A 3.2 Gen 2 port on the left. You'll need one of the Type-C ports for charging, and another for DisplayPort if you're running an external monitor. Luckily, HP bakes in Wi-Fi 7 and Bluetooth 5.4 for your networking and wireless peripherals.

The keyboard looks bland and has annoyingly small Ctrl, Fn and Alt keys, but in practice it's one of the best in this Labs. While there's limited travel the feel is crisp, fast and consistent, and within an hour of use you should be hitting your normal typing speed. We're also fans of HP's touchpad. It's not huge at 125 x 80mm, but it's flawless when it comes to tracking movements, taps and gestures.

One area where the Ultra 14 doesn't excel is its screen. It's a solid IPS panel with a 16:10 aspect ratio and a high 2,240 x 1,400 resolution, with a peak 344cd/m² brightness and 1,201:1 contrast ratio boosted by the glossy surface. However, it still looks slightly drab compared to the richer OLED panels of the Asus laptops or the Yoga Slim 7x, and its colour reproduction skills aren't in the same league: 95% sRGB coverage and 68% DCI-P3 sit in the mid table. Outside of direct comparisons it still looks great when streaming video or browsing through high-resolution photos, and colour accuracy is good enough for professional usage, with an average Delta E of 1.11.

**ABOVE** The OmniBook Ultra 14 packs a punch thanks to its powerful Ryzen AI 9 processor

**The best reason to buy this laptop is performance. The Ryzen AI 9 365 does well across both single-core and multicore benchmarks**

**LEFT** The slim chassis leaves little room for connectivity ports

**BELOW** The IPS panel looks rather drab next to OLED models

The OmniBook has one of the best webcams in this Labs, capturing 1440p video or 4K stills, with superb control of contrast and exposure and little grain even in low-light conditions. Audio is again a cut above most laptops in this Labs; it's punchy, there's depth to it and while it sounds mid-range heavy at high volumes, it's not an unlistenable mess.

But the best reason to buy this laptop is performance. The Ryzen AI 9 365 does well across both single-core and multicore benchmarks while delivering enough GPU and NPU horsepower to score supremely well in the Geekbench AI tests. It also pushes the OmniBook into pole position in the demanding 3DMark Steel Nomad Lite benchmark, and you can buy the OmniBook in the knowledge that performance will translate into playable frame rates in games if you're sensible on settings and resolutions.

You can't say the same about the Snapdragon X machines on test.

And if you suspect that all this comes at the cost of battery life, think again. The OmniBook Ultra 14 triumphs here as well, with over 19 hours of video playback. With speed and stamina to spare, this is an exceptional everyday PC – but only if you choose the cheaper version.

**JARGON BUSTER** **IPS** panels have been dominant in laptops for years, with higher-end displays producing natural-looking whites and strong colours. However, we've recently seen a rise in **OLED** panels which are a great choice for films and photos thanks to their perfect contrast and often punchier colours. See p42 for more details.

# LENOVO YOGA SLIM 7X

## With a stunning screen, cool design and excellent performance, this is a great everyday PC

**SCORE** ★★★★★
**PRICE** £749 (£899 inc VAT)
**from** currys.co.uk

The Yoga Slim 7x has been a fixture on our A-List since Lenovo launched it last year, so it's no surprise to see it triumph in this month's Labs. Its price wobbles depending on promotions, and at one point during our tests it was only this base level version that slipped underneath the £999 price barrier we set for this Labs, but look at what you get for the money: a fantastic 14.5in OLED screen, a gorgeous slimline chassis and one of Qualcomm's high-end Snapdragon X Elite CPUs. It's the Copilot+ PC to beat.

Let's start with the design. With a body that's under 13mm thick the Yoga Slim 7x more than earns its name, while the 1.3kg weight makes it one of the lightest laptops in this Labs. Yet it feels surprisingly robust, with MIL-STD-810H certification for durability. The rather lovely inky blue finish with matching blue keyboard and trackpad is the icing on the style cake.

**LEFT** At just under 13mm thick, the Slim 7x lives up to its name

The price you pay for the super-skinny build is connectivity. You'll find three USB-C 4 ports and that's it, so you'll need adapters or a docking station for any USB-A peripherals or for connecting a monitor that doesn't include a USB-C input. This is also the only laptop on test without a good old-fashioned 3.5mm audio socket. Of course, you can rely on Bluetooth 5.4 connectivity to hook up a wireless mouse and headset, while Wi-Fi 7 has you covered both for existing networks and future upgrades.

The keyboard doesn't have the superb, almost mechanical feel of Lenovo's legendary ThinkPad keyboards, but it's not far off the mark. With no numeric pad to cram in, Lenovo has focused on giving each key plenty of space, and on making the crucial Shift, Ctrl, Enter and Caps Lock keys big and easy to find through touch. The action is light but clicky and tactile, while the slightly concave keys and consistent travel only add to the appeal. The touchpad, meanwhile, is sensitive and smooth.

Unusually for Lenovo, the webcam doesn't have a physical privacy shutter, but that's our only complaint. It captures clear, well-exposed footage in both daylight and artificial lighting, and you can always use Windows Studio Effects to balance brightness levels and blur the background.

The audio is clear but, with only so much space for the speakers, a little thin and brash. It's fine for meetings or music at low volumes, but otherwise you might want to keep those Bluetooth headphones handy.

Luckily, we have no concerns about the screen. It's a fantastic OLED panel with a high 2,944 x 1,840 resolution and a 90Hz refresh rate, and while the gloss surface means it's quite reflective, it's bright enough to compensate. We measured SDR brightness at 493cd/m² and it covers 100% of the DCI-P3 gamut. Colour accuracy is nigh-on perfect with an average Delta E of 0.68.

**ABOVE** Lenovo's Yoga Slim 7x: still the Copilot+ PC to beat

**We have no concerns about the screen. It's a fantastic OLED panel with a high 2,944 x 1,840 resolution and a 90Hz refresh rate**

The Slim 7x still excels when it comes to performance. With 12 cores running at up to 3.4GHz, the Snapdragon X Elite has a clear multithreaded speed advantage over the 8-core and 10-core Snapdragon X Plus processors used elsewhere; the only device to beat the Lenovo in most benchmarks is the AMD-powered HP OmniBook 14 Ultra. The latter has the edge in the Geekbench AI and 3DMark Steel Nomad Lite benchmarks, but the Slim 7x still pulls clear of other Qualcomm and Intel-powered models. Provided you're aware of the compatibility restrictions of Windows on Arm and aren't bothered about gaming this system will never disappoint.

What's more, the Slim 7x has serious stamina. Only one other laptop on test broke the 20-hour barrier in our video-rundown test, and the Lenovo scraped a win by lasting an additional four minutes. That's enough to get you through a couple of days of use without a recharge if you don't max out the brightness and push the CPU too hard. Unless you have good reason to steer clear of Arm, this is the best all-round device on test.

**BELOW** A lovely inky blue finish gives the excellent keyboard a classy look

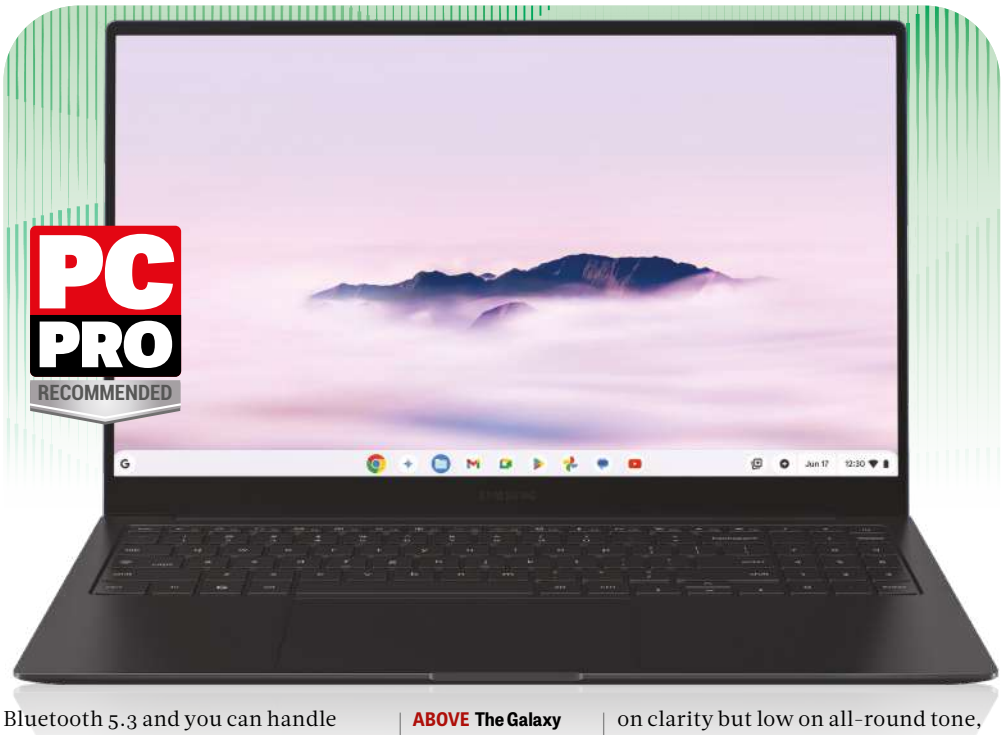
**JARGON BUSTER** **NPU** stands for neural processing unit, which we covered in depth nine months ago (*see issue 362, p34*). They're rated in terms of TOPS, or trillion operations per second, and are great for tasks such as blurring video backgrounds and anything that involves a lot of parallel processing, which includes certain AI tasks.

# SAMSUNG GALAXY CHROMEBOOK PLUS

## The Chromebook king, with strong design and a killer OLED screen that meant we triple-checked the price

**SCORE** ★★★★☆

**PRICE** Core 5, £499 (£599 inc VAT)
**from** samsung.com




This is the undoubted star of this month's Chromebook lineup, thanks to a killer combo of speed, screen and style. It takes its cues from the brand's premium Galaxy Book line, with an all-aluminium body and distinctive inky blue for the base and lid.

At just under 12mm thick and 1.2kg in weight it's thinner and lighter than a 15.6in laptop has any right to be. The construction is solid so you won't have any concerns carrying it around in a bag all day.

Usability is just as good. The keyboard action is light but with clicky tactile feedback, and it's easy to forgive a few quirks about the layout, such as the small cursors and thin numeric pad. This is also one of the first Chromebooks to include Google's Quick Insert key, which replaces the old Launcher key to deliver context-sensitive suggestions or add emojis/links to your work. It's a smart way to integrate Gemini AI features into Chromebooks at a hardware level.

Samsung makes the most of the space beneath the keyboard by fitting in a gigantic touchpad. At 130 x 88mm it's a good match for the 15.6in screen, and almost flawless in its tracking – the "almost" is because it occasionally ignored two-fingered scrolling gestures.

Despite its ultra-slim body the Galaxy Chromebook Plus scores well for connectivity, with two USB-C 3.2 Gen 2 ports, a single USB-A 3.2 Gen 1 port, an HDMI output and a microSD card slot. Add Wi-Fi 6E and Bluetooth 5.3 and you can handle most working scenarios without the need for an external dock.

The OLED screen is – with two quibbles – exceptional, with perfect contrast and rich, vibrant colours. It covers 99% of the DCI-P3 gamut, and while its maximum brightness – 397cd/m² – isn't high enough for outdoor use in direct sunlight, it's great under shade or used indoors. And note that AMOLED panels are always more readable at lower brightness levels than their IPS rivals.

Quibble number one is that colour accuracy isn't good enough for colour-critical work, with an average Delta E of 3.29. That won't affect you when editing smartphone snaps, but creative pros should look elsewhere. Quibble number two is that the 1080p resolution looks blocky on a screen this size, and it would have been fantastic to see this Chromebook with the same 2,880 x 1,620 resolution panel as the Asus Vivobook S15. Its inferior resolution is one of the few signs of the Galaxy Chromebook Plus' low price.

Another is the less than brilliant audio, scoring high on clarity but low on all-round tone, especially at higher volumes, where it quickly gets harsh. The 1080p webcam also struggles with grain and unnatural-looking colours in artificial light, though it's solid enough during daylight hours.

**ABOVE** The Galaxy Chromebook Plus is the best Chromebook you can buy

**If you're happy in Google's web-focused ecosystem, it's a fantastic productivity device, particularly given its all-day battery life**

Samsung sells the Galaxy Chromebook Plus in Intel Core 5 120U and Core 3 100U variants, and the high-end version held up well in our performance tests, coming slightly ahead of the Acer Chromebook Plus 514 and 516. The Core 5 has two P-cores and eight E-cores to the Core 3's two and four, giving it an advantage in multithreaded workloads, while its better-specified GPU gives it the edge in our 3D benchmarks, too.

**LEFT** Despite the ultra-slim body, there are ports aplenty

Chrome OS's lower requirements mean this laptop feels incredibly snappy in everyday use. If you're happy within Google's web-focused ecosystem, it's a fantastic productivity device, particularly given its all-day battery life: it lasted just over 13 hours in our video rundown tests.

**BELOW** The enormous touchpad makes good use of the space below the clicky keyboard

Our only concern is over the bouncy prices. At time of writing, the Core 3 version cost £499 and the Core 5 edition was £599, but Samsung sometimes ups those prices. Still, even at £100 more, the Galaxy Chromebook Plus is the best mainstream option right now.

JARGON BUSTER **Delta E** is a measure of colour accuracy. The rule of thumb is that a figure below 1 is effectively perfect, as the human eye isn't sensitive enough to detect the difference. Anything between 1 and 2 is excellent, but go above 3 and you may notice that certain colours don't look quite right.

# ACER CHROMEBOOK PLUS 514 (2025)

## An improvement on the old model but not the most exciting Chromebook Plus device you can buy

**SCORE** ★★★☆☆

**PRICE** From £333 (£399 inc VAT)
**from** acer.com

2023's Chromebook Plus 514 was at the crest of the initial wave of Chromebook Plus devices, and now returns with updated internals: farewell AMD Ryzen 3 7320C, a big welcome to Intel's Core 3-100U.

In other respects, changes are limited. It's slightly smaller, with a footprint of 316 x 227mm, while the two-tone plastic lid has been switched for aluminium. There's some flex here, but nothing major, and the mostly plastic chassis passes a few of the MIL-STD-810H tests for durability.

Acer has been reasonably generous on connectivity, with two USB-C 3.2 Gen 2 ports on the left-hand side plus a single USB-A 3.2 Gen 1 connector, and a second USB-A port on the right-hand side along with an HDMI output. Wireless connectivity is even better thanks to the inclusion of Wi-Fi 7.

**ABOVE** This is a solid Chromebook that lacks the wow factor

The keyboard isn't perfect, with some side-to-side wobble on the chiclet keys and undersized Ctrl and Fn keys on the left, but the typing action is surprisingly good thanks to plenty of travel and a crisp return. Meanwhile, Acer's OceanGlass touchpad aims to provide the feel of glass in a pad made out of recycled ocean-bound plastic. It's not 100% convincing, but it still works effectively.

The screen is a mixed bag. Highlights include a maximum brightness of 321cd/m² and low-ish black levels of 0.24cd/m², giving a better-than-average contrast of 1,334:1. The 1,920 x 1,200 resolution looks fine on a 14in screen, but don't expect punchy colours: it covers a lowly 58% of the sRGB colour gamut and 41% of DCI-P3, while colour accuracy is only just acceptable.

The switch from AMD's Ryzen 3 7320C to the Intel Core 3 100U is an improvement. The old CPU had four cores capable of running eight threads at up to 4.1GHz, while the new one has two P-cores and four E-cores running eight threads at up to 4.7GHz. This is enough to boost scores in the Geekbench 6 benchmark from 1,171 (single-core) and 3,537 (multicore) to 1,923 and 5,729.

It's no powerhouse even by Chromebook standards, but it's fast enough to keep Chrome OS and its apps and AI features running smoothly. Add reasonable battery life and you've got a decent Chromebook – but one that doesn't match the quality of its Chromebook Plus rivals.

# ACER CHROMEBOOK PLUS 516 (2025)

## A solid 15.6in alternative to the Samsung Chromebook Plus if you're on a more limited budget

**SCORE** ★★★★☆

**PRICE** From £333 (£399 inc VAT)
**from** acer.com

The new Chromebook Plus 516 takes over from the Chromebook Plus 515 as the big-screen option in Acer's Chromebook lineup, bringing in faster Intel Core CPUs and an additional inch of screen size. Unsurprisingly, it's a whopper, measuring 359 x 253 x 19mm and weighing 1.7kg. It feels rock solid, but there's no ignoring the bulk, even with Acer's clever sculpting. However, the bigger screen and ergonomic advantages more than compensate if you spend your working life bound to a desk.

**ABOVE** The huge 16in display may be beneficial if you spend your life tied to a desk

In an ideal world the screen would be the Plus 516's biggest selling point, but some compromises have been made. The 1,920 x 1,200 resolution looks blocky when stretched over a 16in diagonal, while colour reproduction is sub-par, with the IPS panel covering only 61% of the sRGB colour gamut and 44% of DCI-P3. Throw in a mediocre maximum brightness of just 280cd/m² and you have a screen that can look dull.

The width leaves plenty of space for a full-sized keyboard and numeric pad, while the flat-topped chiclet keys have plenty of travel and some tactile response. The touchpad could be bigger, but it's smooth and doesn't have any niggling issues with its tracking.

There's little to grumble about on the connectivity front, even if you don't benefit from the latest high-performance ports. Instead, you get two slow-ish USB-A 3.2 Gen 1 ports, one on each side, plus an HDMI 1.4 output and a pair of faster USB-C 3.2 Gen 2 ports. Both sit on the left-hand side. The final connectivity to note is Wi-Fi 6E plus Bluetooth 5.3.

The Chromebook Plus 516 comes in a choice of Core 3 100U, Core 5 120U and Core 7 150U CPUs, all partnered with 8GB of RAM and 128GB of UFS storage. UFS is faster than the old MMC flash storage, but not as speedy as a more conventional PCIe Gen 4 SSD.

Either way, the Chromebook Plus 516 trailed the Samsung Galaxy Chromebook Plus across our benchmarks, though in practice, running apps and browsing, it feels snappy and responsive. Battery life is a little disappointing, but this is a respectable big-screen Chromebook at a good price.

## ACER CHROMEBOOK SPIN 312

A flexible, compact Chromebook with several handy features, but it's just too slow to recommend

SCORE ★★★☆☆

**PRICE £274 (£329 inc VAT)**
**from acer.com**

In many ways, the Acer Chromebook Spin 312 feels like something of a step back to the days when Chromebooks were seen as secondary devices or school PCs, but that isn't necessarily a bad thing. It's compact, inexpensive and versatile, with a 360° hinge that allows it to be used as a small laptop, a chunky tablet or in a tent configuration. At 289 x 204 x 19.9mm, it takes up barely any room in a bag or backpack, and is small enough to use on a train or busy coffee shop. At 1.29kg, it's light but pleasingly robust.

What's more, its 12.2in screen is surprisingly capable. A glossy surface adds reflectivity but also helps boost contrast, and while the maximum 302cd/m² brightness isn't stellar it's better than you'll find on most budget Chromebooks. Surprisingly, coverage of the sRGB and DCI-P3 colour gamuts is marginally better here than on Acer's more expensive Chromebook Plus models.

More surprisingly still, usability isn't affected by the smaller size. The touchpad is tiny – just 104 x 60mm – but is sensitive enough to track pointer movement and gestures accurately across the screen. The keyboard has a straightforward layout with good-sized Shift, Ctrl and Alt keys, and while the keycaps feel a little wobbly, the action is crisp and speedy. You also have the touchscreen, complete with anti-microbial Gorilla Glass, for tablet use.

**ABOVE The versatile Spin 312 can be used as a laptop, a tablet or in tent mode**

The only disappointments are the lack of a garaged stylus and having a single USB-C 3.2 Gen 1 port (needed for charging), though you do get two USB-A 3.2 Gen 1 ports, a 3.5mm audio socket and an HDMI 1.4 output.

The dealbreaker here is performance. The Intel N100 processor is about as low-end as Intel CPUs get, and to make it worse Acer has fitted just 4GB of RAM, which shouldn't even be an option in 2025. As a result, the Spin 312 came last in every benchmark, and can feel sluggish in actual use unless you're disciplined with browser tabs and unused apps. It can still serve as a secondary computer, but it desperately needs more power.

# Chromebook Plus & Gemini

We reveal the state of play with Google's AI-enhanced operating system

Chromebook Plus with Gemini launched in May 2024 with a limited range of AI features, including generative AI wallpapers and Magic Editor for Google Photos. This allows you to delete unwanted objects, much as you can on a Pixel phone. Naturally, Google has added more AI features since.

The strongest additions are "Help me write", "Help me read" and Live Translate. "Help me write" provides access to Gemini's text-generation features. Click inside a text box, an email message or a Google Doc, and you'll be prompted to let Gemini help, and all you need to do is offer basic instructions and context, click Create and you're away.

"Help me read" puts Gemini to use in summarising. Select some text in a document or web page, then right-click and pick "Summarize with Help me read" from the menu, and Gemini will break it down into a short summary, with the option to ask follow-up questions for more detail.

Live Translate is exactly what you might expect, translating audio in video and media streams from one of over 100 supported languages into another in real-time while you watch. Live transcription is also on offer through a Chrome OS version of the Pixel series' excellent Recorder app.

The latest Chromebook Plus devices come with a Quick Insert key, providing instant context-sensitive access to "Help me write", related links, Google Drive files, GIFs and emojis with a quick tap. Meanwhile, a new Welcome Recap feature makes it easier to restart exactly where you left off, with the same apps and browser tabs open, even signed in to the same cloud-based services.

**ABOVE Google's Gemini AI has become far more useful in its recent iterations**

It's unclear how many of these tools use local AI processing and how many rely on services running in the cloud. On the plus side, Google's hybrid local/cloud AI processing allows Gemini tools to run on lower-grade hardware without powerful integrated graphics or an onboard NPU. On the downside, this leaves you dependent on an internet connection, and without the speed and latency advantages of doing all or most of the processing offline.

Google deserves credit for making AI so affordable and accessible, especially when it still bundles in a year's subscription to the Google One AI Premium plan with every Chromebook Plus purchase. But is it limiting the potential of what you'll be able to do with it later on?

# HP CHROMEBOOK PLUS X360 14B-CD0000NA

## A large 2-in-1 but it's let down by a dull screen and a dated CPU, leaving us questioning the "Plus"

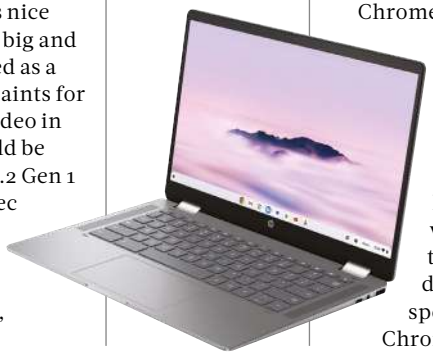
**SCORE** ★★☆☆☆

**PRICE** £316 (£379 inc VAT) **from** hp.com

HP's convertible Chromebook Plus might not have the cute 12.2in form factor of the Acer Chromebook Spin 312, but it has several practical advantages, including a faster Core i3 N305 CPU and double the 4GB of RAM. It's still not a star performer, thanks to the processor's dated Alder Lake-N architecture, and the scores across our benchmarks are substantially lower than on the new Acer devices, both in our single-core and multithreaded tests. However, it makes the Chromebook Plus x360 a better option than the Acer for basic browsing and light office use.

The laptop itself looks and feels as dated as the CPU, with a chunky 323 x 210 x 20.4mm body that's big on silver plastic, though it looks nice enough when closed. It's too big and clunky to work single-handed as a tablet, but we have no complaints for presentations or watching video in tent mode. Connectivity could be improved, with two USB-C 3.2 Gen 1 ports, both stuck at 5Gbits/sec speeds, a headset socket and a single 5Gbits/sec USB-A port. Even the Wi-Fi has slipped behind the times, supporting basic Wi-Fi 6.

**ABOVE** A convertible laptop that looks and feels dated



The 14in screen is bigger than the Acer's but not necessarily better. The Acer's 16:10 aspect ratio and 1,920 x 1,200 resolution makes it feel larger than it actually is, while it goes brighter than the HP's 229cd/m² and gives you higher sRGB coverage to boot. The HP looks surprisingly dull in comparison.

The keyboard is reasonable enough, with large flat-topped keys and a sensible, straightforward layout. All the same, there's something spongey about the typing action and a noticeable wobble if you don't hit dead centre on the keys. Meanwhile, the touchpad feels undersized and suffers from a stiff but hollow click. Even remembering that this is a cheap Chromebook, the Chromebook Plus x360 isn't as comfortable in daily use as the Acer Chromebook Plus 514.

What's more, the HP's battery life is inferior to both the 514 and the Spin 312, with the battery running flat just shy of ten-and-a-half hours. There are far worse Chromebooks out there, but this one could do with more quality and speed to justify the Chromebook Plus tag.

# MSI MODERN 15 F1MG

## A great specification for the price, but rivals offer more quality in every meaningful area, so buy with caution

**SCORE** ★★★☆☆

**PRICE** £583 (£699 inc VAT)
**from** currys.co.uk

MSI's 15.6in laptop packs in an impressive spec for its budget price, with an Intel Core 7 processor, 16GB of RAM and a large Full HD display. A couple of years ago it would have been hard to beat on bang for buck. However, the arrival of Qualcomm's Snapdragon X CPUs has mixed things up, and now the Modern 15F1MG faces stiffer competition.

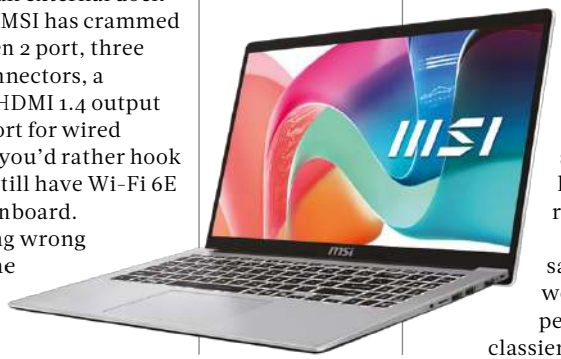
It's a solidly built if plastic-heavy laptop, with a 359 x 236mm desktop footprint and a weight of 1.7kg. Sure, it's hefty, but that translates to decent ergonomics, with a wide keyboard, large touchpad and a comfortable typing position. The

chiclet keys are backlit and the layout straightforward, with well-sized Shift and Ctrl keys, separate cursors and even a slim numeric pad. The action is slightly soft, but it's consistent across the keyboard and quiet.

You won't need an external dock for this one, either. MSI has crammed in one USB-C 3.2 Gen 2 port, three USB-A 3.2 Gen 1 connectors, a microSD card slot, HDMI 1.4 output and even an RJ45 port for wired gigabit Ethernet. If you'd rather hook up wirelessly, you still have Wi-Fi 6E and Bluetooth 5.3 onboard.

Things start going wrong with the display. The 1080p resolution isn't a disaster, even across a 15.6in panel, but combine it with a maximum brightness that only just exceeds 250cd/m² and the word "dull" springs to mind. Even more so when it covers a mere 63% of the sRGB colour gamut and 45% of DCI-P3, while colour accuracy is also far from ideal. Throw in a low-resolution webcam that captures grainy footage and tinny sound and there's not much to love on the audio-visual front.

**ABOVE** The decent spec can't make up for a dull screen and poor performance



Performance is similarly underwhelming. You might expect the 10-core, 12-thread Core 7 to be fast, but it only has two speedy P-cores among eight power-efficient E-cores, meaning it struggles to keep up with even the 8-core and 10-core Snapdragon X Plus processors used elsewhere. It holds up better in 3D benchmarks, though not to the point of keeping gamers happy, but the battery lasted a lowly seven-and-a-half hours in our video-rundown test.

Even at £699, a £150 saving from its list price, we would steer most people towards the classier Asus Vivobook S15.

# How we test

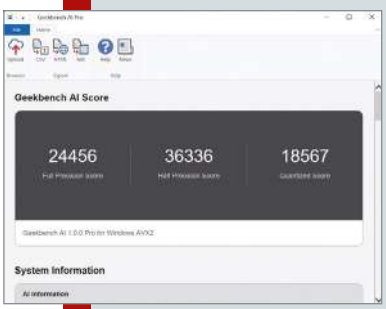
Chromebooks can't run all of our regular benchmarks, and even Snapdragon X Copilot+ PCs baulk at running PCMark 10. As a result, we've focused on cross-platform and browser-based tests.

Geekbench 6 provides a good idea of single-core and multicore performance, plus GPU horsepower (in Geekbench 6 Compute). We've also experimented with the Geekbench AI benchmark, testing both GPU and NPU AI performance, and listing the best result for each machine.

WebXprt 4 gives a solid indication of performance in web-based applications, while Basemark 3 and JetStream cover a selection of workloads and push multitasking performance. We've also used the multitasking test we usually run on Chromebooks, running a 4K video in the background while running the Basemark 3 and JetStream benchmarks simultaneously. We report the JetStream 2.2 result.

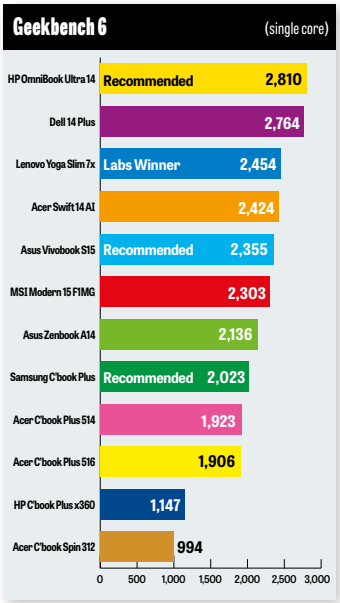
3DMark simulates the kind of 3D performance you'd expect to see in modern games, and we've used the more demanding Wild Life Extreme and Steel Nomad Lite benchmarks, as the former runs on both Windows and Chrome OS devices and the latter uses more advanced graphics techniques and effects.

Finally, we test battery life by setting the brightness level to a uniform 170cd/m², then setting a 1080p video to play back on a loop until the battery runs down.




**ABOVE** **We print Geekbench AI scores for info only**

# Geekbench results


Geekbench 6 (single core)
HP OmniBook Ultra 14 Recommended 2,810
Dell 14 Plus 2,764
Lenovo Yoga Slim 7x Labs Winner 2,454
Acer Swift 14 AI 2,424
Asus Vivobook S15 Recommended 2,355
MSI Modern 15 F1MG 2,303
Asus Zenbook A14 2,136
Samsung C'book Plus Recommended 2,023
Acer C'book Plus 514 1,923
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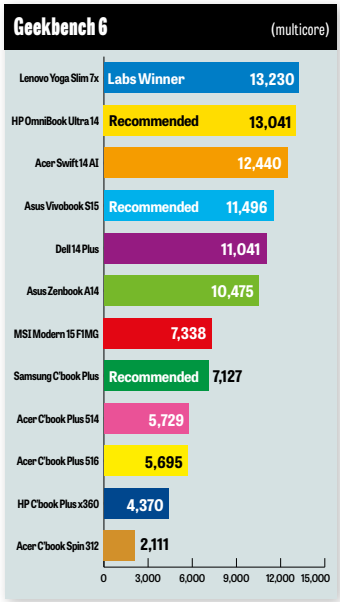
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HP OmniBook Ultra 14 Recommended 13,041
Acer Swift 14 AI 12,440
Asus Vivobook S15 Recommended 11,496
Dell 14 Plus 11,041
Asus Zenbook A14 10,475
MSI Modern 15 F1MG 7,338
Samsung C'book Plus Recommended 7,127
Acer C'book Plus 514 5,729
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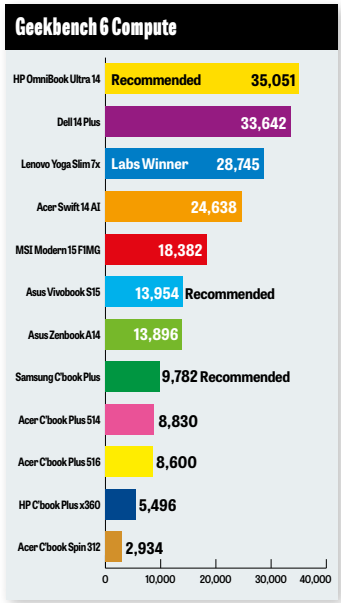
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Asus Vivobook S15 13,954 Recommended
Asus Zenbook A14 13,896
Samsung C'book Plus 9,782 Recommended
Acer C'book Plus 514 8,830
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HP C'book Plus x360 5,496
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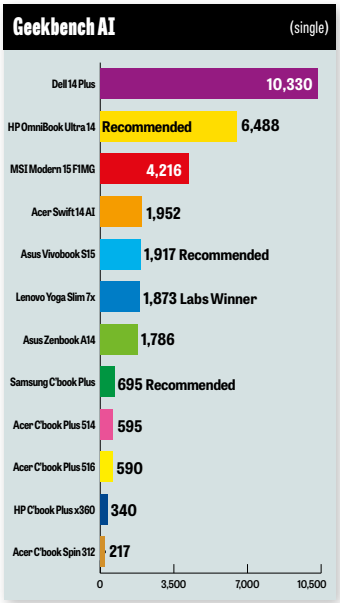
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HP OmniBook Ultra 14 Recommended 6,488
MSI Modern 15 F1MG 4,216
Acer Swift 14 AI 1,952
Asus Vivobook S15 1,917 Recommended
Lenovo Yoga Slim 7x 1,873 Labs Winner
Asus Zenbook A14 1,786
Samsung C'book Plus 695 Recommended
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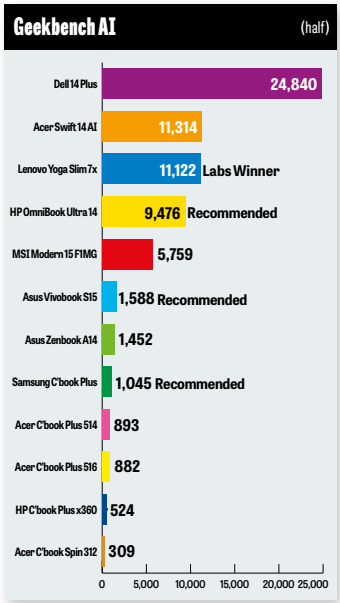
Geekbench AI (half)
Dell 14 Plus 24,840
Acer Swift 14 AI 11,314
Lenovo Yoga Slim 7x 11,122 Labs Winner
HP OmniBook Ultra 14 9,476 Recommended
MSI Modern 15 F1MG 5,759
Asus Vivobook S15 1,588 Recommended
Asus Zenbook A14 1,452
Samsung C'book Plus 1,045 Recommended
Acer C'book Plus 514 893
Acer C'book Plus 516 882
HP C'book Plus x360 524
Acer C'book Spin 312 309
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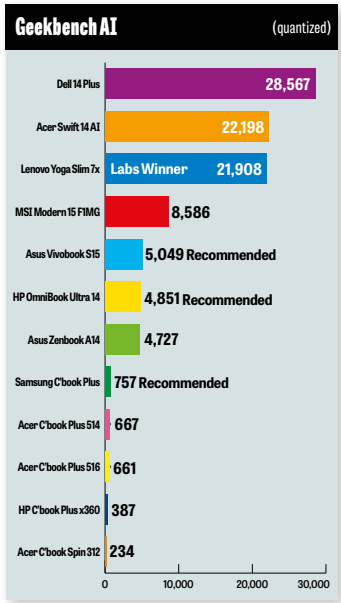
Geekbench AI (quantized)
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Acer Swift 14 AI 22,198
Lenovo Yoga Slim 7x Labs Winner 21,908
MSI Modern 15 F1MG 8,586
Asus Vivobook S15 5,049 Recommended
HP OmniBook Ultra 14 4,851 Recommended
Asus Zenbook A14 4,727
Samsung C'book Plus 757 Recommended
Acer C'book Plus 514 667
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HP C'book Plus x360 387
Acer C'book Spin 312 234
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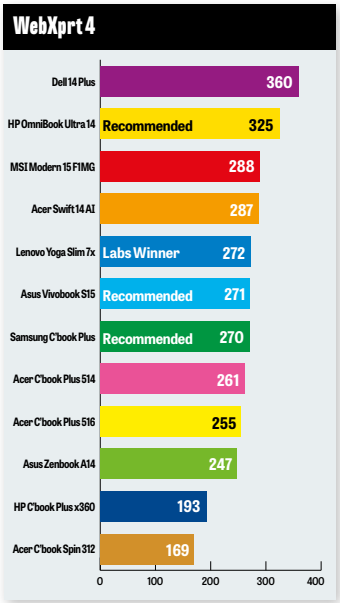
# Web-based benchmarks


WebXprt 4
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HP OmniBook Ultra 14 Recommended 325
MSI Modern 15 F1MG 288
Acer Swift 14 AI 287
Lenovo Yoga Slim 7x Labs Winner 272
Asus Vivobook S15 Recommended 271
Samsung C'book Plus Recommended 270
Acer C'book Plus 514 261
Acer C'book Plus 516 255
Asus Zenbook A14 247
HP C'book Plus x360 193
Acer C'book Spin 312 169
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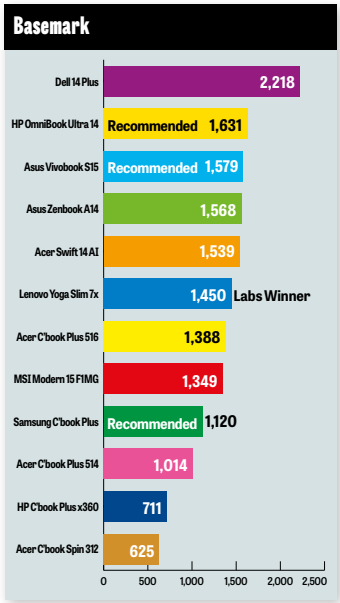
Basemark
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HP OmniBook Ultra 14 Recommended 1,631
Asus Vivobook S15 Recommended 1,579
Asus Zenbook A14 1,568
Acer Swift 14 AI 1,539
Lenovo Yoga Slim 7x 1,450 Labs Winner
Acer C'book Plus 516 1,388
MSI Modern 15 F1MG 1,349
Samsung C'book Plus Recommended 1,120
Acer C'book Plus 514 1,014
HP C'book Plus x360 711
Acer C'book Spin 312 625
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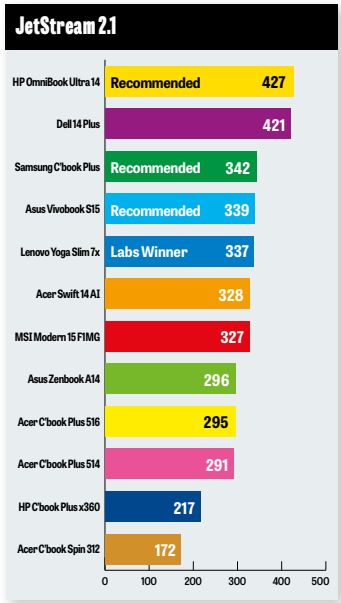
JetStream 2.1
HP OmniBook Ultra 14 Recommended 427
Dell 14 Plus 421
Samsung C'book Plus Recommended 342
Asus Vivobook S15 Recommended 339
Lenovo Yoga Slim 7x Labs Winner 337
Acer Swift 14 AI 328
MSI Modern 15 F1MG 327
Asus Zenbook A14 296
Acer C'book Plus 516 295
Acer C'book Plus 514 291
HP C'book Plus x360 217
Acer C'book Spin 312 172
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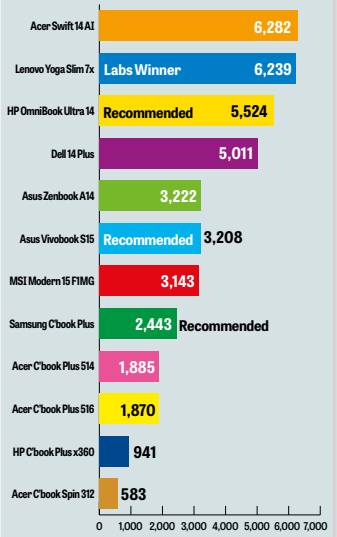
# 3DMark and multitasking

## 3DMark Wild Life Extreme


Acer Swift 14 AI 6,282
Lenovo Yoga Slim 7x Labs Winner 6,239
HP OmniBook Ultra 14 Recommended 5,524
Dell 14 Plus 5,011
Asus Zenbook A14 3,222
Asus Vivobook S15 Recommended 3,208
MSI Modern 15 F1MG 3,143
Samsung C'book Plus 2,443 Recommended
Acer C'book Plus 514 1,885
Acer C'book Plus 516 1,870
HP C'book Plus x360 941
Acer C'book Spin 312 583
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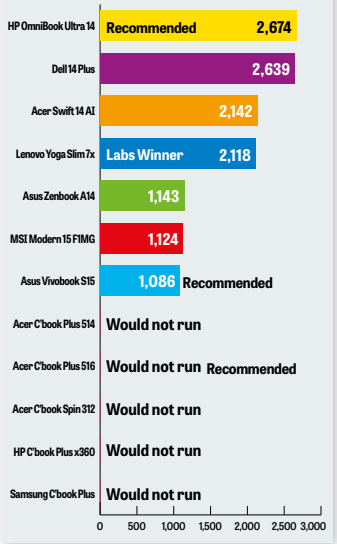
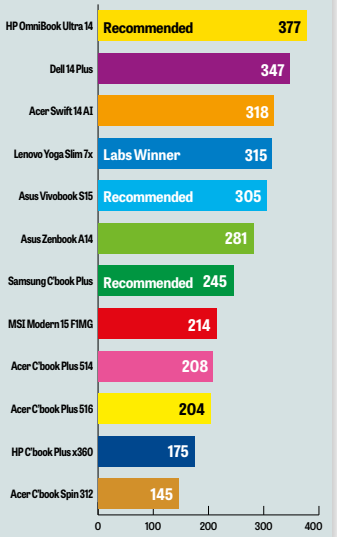
## 3DMark Nomad Lite

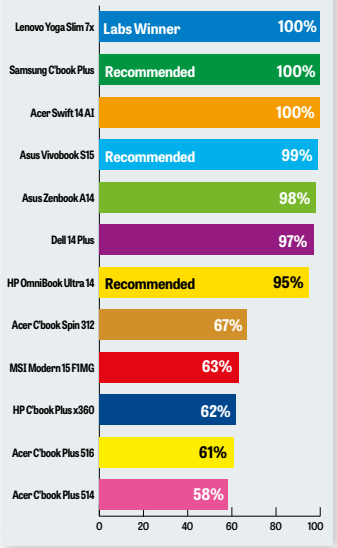

HP OmniBook Ultra 14 Recommended 2,674
Dell 14 Plus 2,639
Acer Swift 14 AI 2,142
Lenovo Yoga Slim 7x Labs Winner 2,118
Asus Zenbook A14 1,143
MSI Modern 15 F1MG 1,124
Asus Vivobook S15 1,086 Recommended
Acer C'book Plus 514 Would not run
Acer C'book Plus 516 Would not run Recommended
Acer C'book Spin 312 Would not run
HP C'book Plus x360 Would not run
Samsung C'book Plus Would not run
0 500 1,000 1,500 2,000 2,500 3,000

## Multitasking (relative scores)

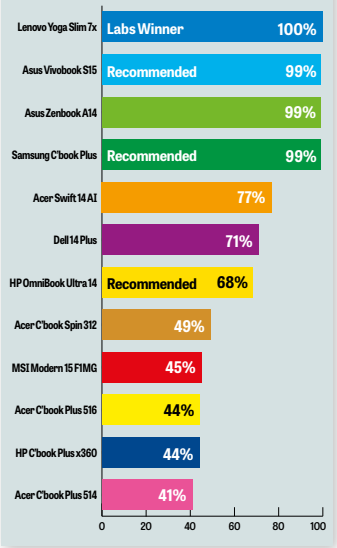

HP OmniBook Ultra 14 Recommended 377
Dell 14 Plus 347
Acer Swift 14 AI 318
Lenovo Yoga Slim 7x Labs Winner 315
Asus Vivobook S15 Recommended 305
Asus Zenbook A14 281
Samsung C'book Plus Recommended 245
MSI Modern 15 F1MG 214
Acer C'book Plus 514 208
Acer C'book Plus 516 204
HP C'book Plus x360 175
Acer C'book Spin 312 145
0 100 200 300 400

# Display tests

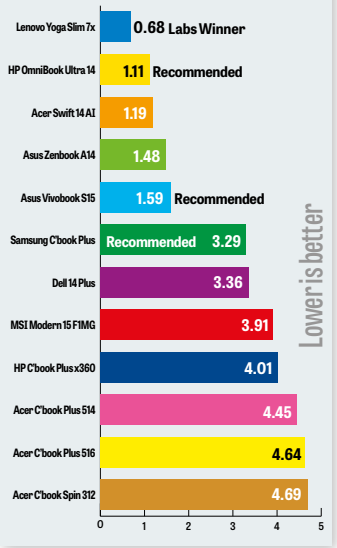
## sRGB coverage


Lenovo Yoga Slim 7x Labs Winner 100%
Samsung C'book Plus Recommended 100%
Acer Swift 14 AI 100%
Asus Vivobook S15 Recommended 99%
Asus Zenbook A14 98%
Dell 14 Plus 97%
HP OmniBook Ultra 14 Recommended 95%
Acer C'book Spin 312 67%
MSI Modern 15 F1MG 63%
HP C'book Plus x360 62%
Acer C'book Plus 516 61%
Acer C'book Plus 514 58%
0 20 40 60 80 100

## DCI-P3 coverage


Lenovo Yoga Slim 7x Labs Winner 100%
Asus Vivobook S15 Recommended 99%
Asus Zenbook A14 99%
Samsung C'book Plus Recommended 99%
Acer Swift 14 AI 77%
Dell 14 Plus 71%
HP OmniBook Ultra 14 Recommended 68%
Acer C'book Spin 312 49%
MSI Modern 15 F1MG 45%
Acer C'book Plus 516 44%
HP C'book Plus x360 44%
Acer C'book Plus 514 41%
0 20 40 60 80 100

## Average Delta-E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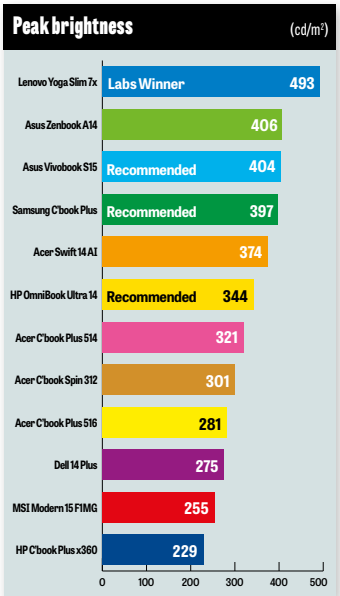
HP OmniBook Ultra 14 1.11 Recommended
Acer Swift 14 AI 1.19
Asus Zenbook A14 1.48
Asus Vivobook S15 1.59 Recommended
Samsung C'book Plus Recommended 3.29
Dell 14 Plus 3.36
MSI Modern 15 F1MG 3.91
HP C'book Plus x360 4.01
Acer C'book Plus 514 4.45
Acer C'book Plus 516 4.64
Acer C'book Spin 312 4.69
Lower is better
0 1 2 3 4 5

## Peak brightness (cd/m²)


Lenovo Yoga Slim 7x Labs Winner 493
Asus Zenbook A14 406
Asus Vivobook S15 Recommended 404
Samsung C'book Plus Recommended 397
Acer Swift 14 AI 374
HP OmniBook Ultra 14 Recommended 344
Acer C'book Plus 514 321
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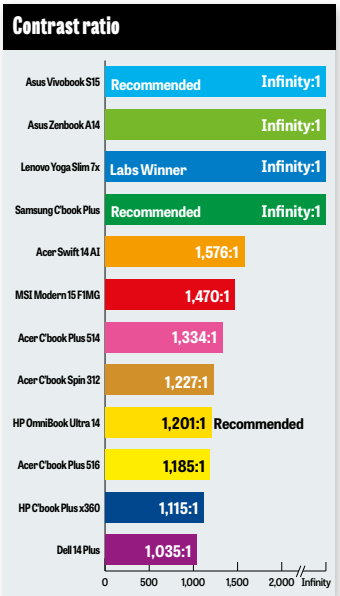
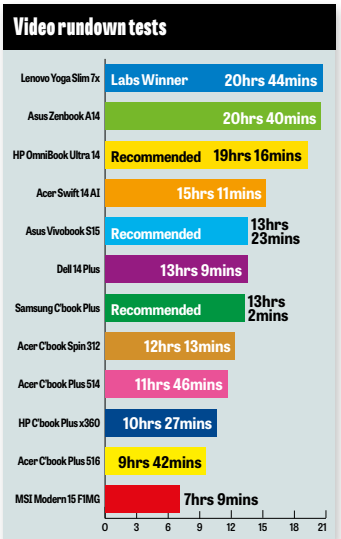
Dell 14 Plus 275
MSI Modern 15 F1MG 255
HP C'book Plus x360 229
0 100 200 300 400 500

## Contrast ratio


Asus Vivobook S15 Recommended Infinity:1
Asus Zenbook A14 Infinity:1
Lenovo Yoga Slim 7x Labs Winner Infinity:1
Samsung C'book Plus Recommended Infinity:1
Acer Swift 14 AI 1,576:1
MSI Modern 15 F1MG 1,470:1
Acer C'book Plus 514 1,334:1
Acer C'book Spin 312 1,227:1
HP OmniBook Ultra 14 1,201:1 Recommended
Acer C'book Plus 516 1,185:1
HP C'book Plus x360 1,115:1
Dell 14 Plus 1,035:1
0 500 1,000 1,500 2,000 Infinity

# Battery life

## Video rundown tests


Lenovo Yoga Slim 7x Labs Winner 20hrs 44mins
Asus Zenbook A14 20hrs 40mins
HP OmniBook Ultra 14 Recommended 19hrs 16mins
Acer Swift 14 AI 15hrs 11mins
Asus Vivobook S15 Recommended 13hrs 23mins
Dell 14 Plus 13hrs 9mins
Samsung C'book Plus Recommended 13hrs 2mins
Acer C'book Spin 312 12hrs 13mins
Acer C'book Plus 514 11hrs 46mins
HP C'book Plus x360 10hrs 27mins
Acer C'book Plus 516 9hrs 42mins
MSI Modern 15 F1MG 7hrs 9mins
0 3 6 9 12 15 18 21

# View from the Labs

**In 2024, Microsoft and Google went big with AI rebrands, but Stuart Andrews wants more**

Last year Microsoft and Google firmly latched the AI bandwagon to their laptops. Copilot+ PCs integrated AI features into Windows, while Google boosted its Chromebook Plus laptops with its all-new Gemini.

Neither have wowed me. The positives for Copilot+ PCs are more to do with battery life and performance than its local AI features. If anything, it's the silicon that stars, and Qualcomm's Arm-based chips in particular. Early Windows on Arm compatibility issues have improved, but not disappeared: missing hardware drivers and poor games support remain an issue. Still, there's no hiding from Qualcomm's impact. This month I tested fast Windows laptops with gorgeous screens at prices that were unthinkable even two years ago.

Then we come to the Chromebook Plus rebrand. Its results are... mixed. If Google's dream was to offer a premium Chromebook experience with enough performance for new AI tools and features, the reality turns out to be a bunch of stolid, low-cost laptops with solid but entry-level specs.

The outlier is Samsung's Galaxy Chromebook Plus, but even that uses Intel's low-end Core CPUs and trims corners with a relatively low-resolution OLED screen. Acer clearly has its eye on value and volume with the Chromebook Plus 514 and 516, while Asus and HP seem to be abandoning "premium" Chromebooks, for now at least. That's a shame, as Chrome OS is a great choice for an everyday PC and it isn't being given a chance to shine.

So while I leave this Labs knowing that cheap PCs have never been better, there's room for more innovation and competition. Even at this level.

**Stuart Andrews has been reviewing laptops since 1998 and can confirm that they have got significantly better**

# Bag a software bargain

Don't pay full price for software when we can offer you huge reductions on genuine products

## NORTON 360 DELUXE for £14.99

SAVE 90%

**3 DEVICES** **2YR LICENCE**

**tinyurl.com/nortondeluxe2025**

We've negotiated this exclusive deal for *PC Pro* readers. No subscriptions, just a one-off bargain price of £14.99 compared to the regular £149.99 charge. That buys you two years of cover from the powerful Norton Security suite across three devices, and there's no danger of being hit with hiked renewal fees.

Because it's the Deluxe version of Norton 360, you get a host of extra tools. Top of the list is the full version of Norton VPN, both to protect your identity and provide a way of watching British TV while you're abroad.

There's also 25GB of cloud storage for secure backup, while Norton's Dark Web Monitoring service will alert you if private details – such as your email address and passwords – have been compromised online.

Norton Parental Control provides tools to see exactly what your kids are up to on their various devices, and you also get GPS location monitoring for Android and iOS.

To round things off, Norton Password Manager generates and stores passwords across all your devices, while SafeCam for PC stops cybercriminals attempting to take photos with your webcam without your knowledge.

## WINDOWS 11 PRO UPGRADE for £49.99

SAVE 58%

**1 PC** **PERPETUAL LICENCE**

**tinyurl.com/win11pro-upgrade**

Want to upgrade from Windows 11 Home to Windows 11 Pro? Or perhaps you're looking to move up from Windows 10 Home?

Whatever your motives, a Windows 11 Pro upgrade licence is a great choice. Microsoft charges £119.99 for a retail licence of Windows 11 Home, £219.99 for Windows 11 Pro, and £119.99 for its own upgrade licence from 11 Home to Pro.

Unlike Windows 11 Home, Windows 11 Pro enables you to connect to a business domain. It also provides BitLocker to encrypt whole drives. Best of all, you can create and host virtual machines using Hyper-V, which is ideal for testing new software or, if you're a developer, seeing how your software performs on a fresh OS.

Note that the upgrade only works from an activated copy of Windows 11 Home, so if you're using Windows 10 Home then you'll need to upgrade to Windows 11 first. Want to upgrade from Windows 7 or 8? Or building a PC from scratch? Head to **tinyurl.com/windowspro11** and grab a full 1-PC licence for Windows 11 Pro for only £79.99.

## CCLEANER 6 PROFESSIONAL for £10

SAVE 75%

**1 PCs** **1YR LICENCE**

**tinyurl.com/ccleaner6pro**

When it comes to PC optimisers, we can think of only one brand that has a consistent reputation for delivering results: CCleaner. This is the professional version, so as you would expect it comes with a bunch of extra tools compared to the free edition.

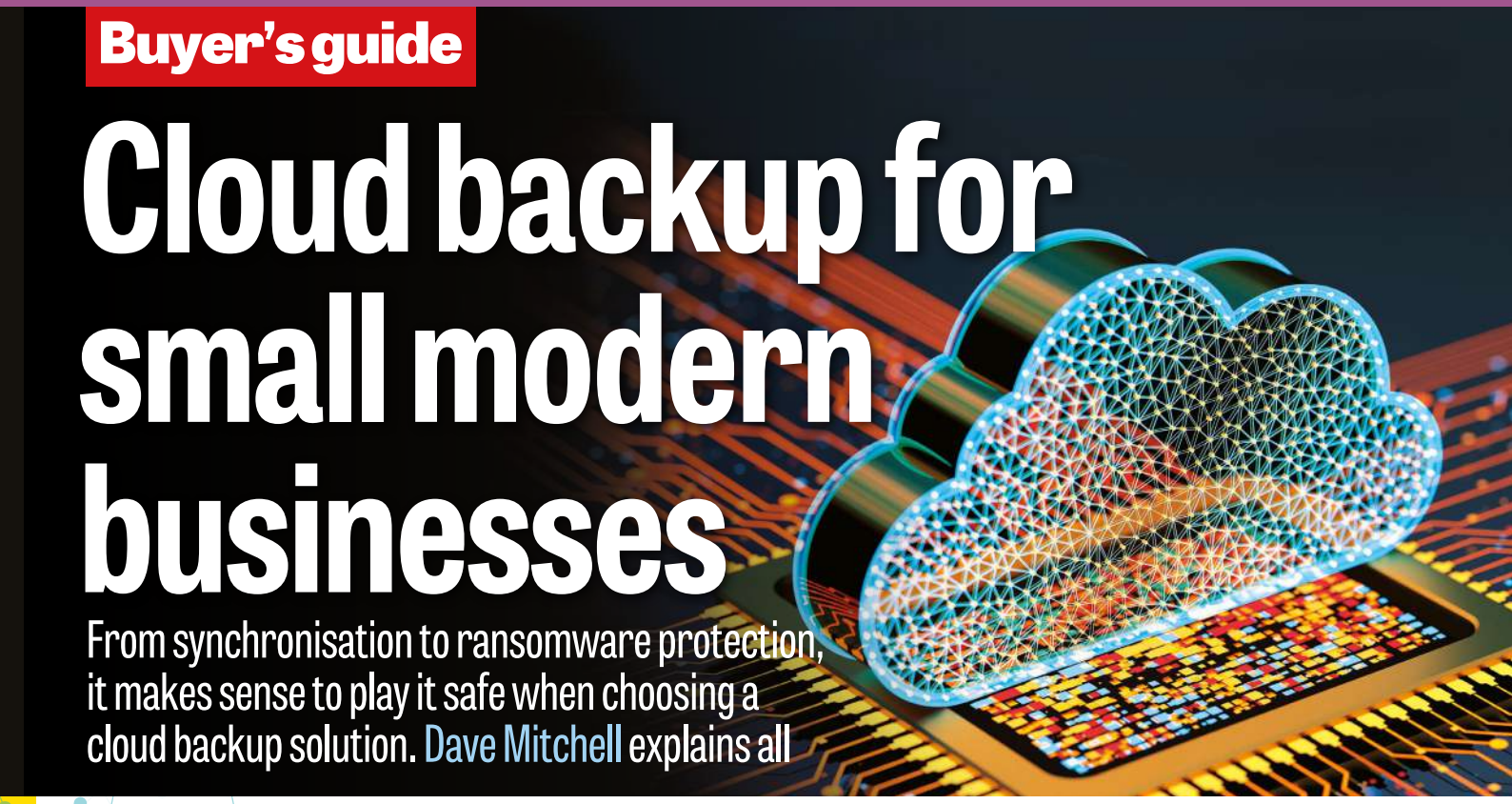
First up is the new Cloud Driver Cleaner. This scans Google Drive for duplicates, large files and old versions, so you can quickly reclaim space. You also benefit from our old friend Performance Optimizer, with CCleaner promising up to 34% more speed and 30% more battery life.

Despite improvements in Windows' own tools, we remain fans of third-party apps such as Driver Updater to keep track of updates – often solving problems such as bugs and unexplained crashes long before Microsoft. Likewise Software Updater, which can close security holes before they come to your notice.

Add priority support, real-time monitoring and scheduled cleaning, and you're getting an awful lot for your £10 investment. And whereas a one-year licence costs £39.95 when bought directly from the CCleaner website, we're offering it at a massive 75% discount.

Buyer's guide

# Cloud backup for small modern businesses



From synchronisation to ransomware protection, it makes sense to play it safe when choosing a cloud backup solution. Dave Mitchell explains all

Backup is an essential process for all businesses, and those that don't have a clearly defined data protection strategy are taking unnecessary risks. A major data loss can be catastrophic; many businesses won't survive long without access to essential information such as customer records, quotes, orders, invoices and payment details.

An accidentally deleted file is an inconvenience at best, but businesses must now protect their data from an ever increasing number of threats that can cause far more reputational harm. These include theft, burglary, environmental disasters such as fire and flood and, of course, data breaches and ransomware attacks.

All protection strategies must include off-site backup, and the cloud is the ideal candidate for this. The best backup products include cloud storage in their subscriptions so you simply pay for what you need.

This month, we've tested four affordable backup solutions from BackupVault, Barracuda, IDrive and Synology. We've chosen these services as they all include cloud storage so you don't need to worry about sourcing it from a third party.

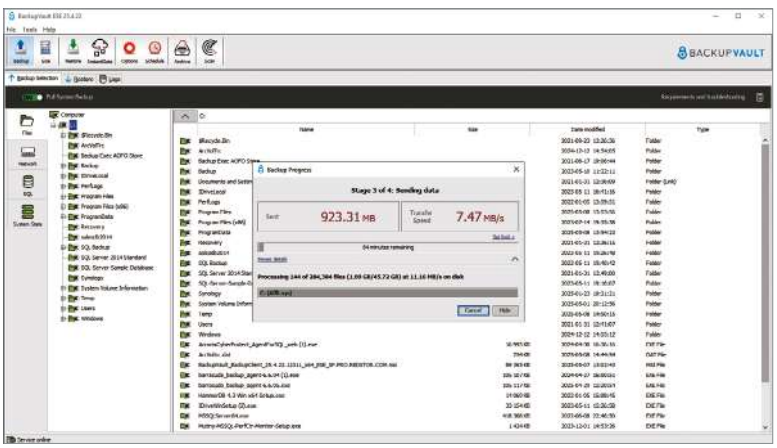
## Out of sync

Don't be tempted to use low-cost cloud file-syncing services as they are not, and never will be, an alternative to business backup. They are designed to provide convenient file-sharing across multiple users along with cloud collaboration tools, but won't protect you from a disaster.

Backup should be a critical part of a full business recovery plan that takes into account every conceivable threat. And for that plan to work, your data always needs to be available.

A common backup strategy is to maintain multiple copies of data in different physical locations so it's always accessible. The easiest way to understand this is to use the "3-2-1" principle, where you retain three up-to-date copies of your data, back it up to two different types of storage media and keep one copy off-site.

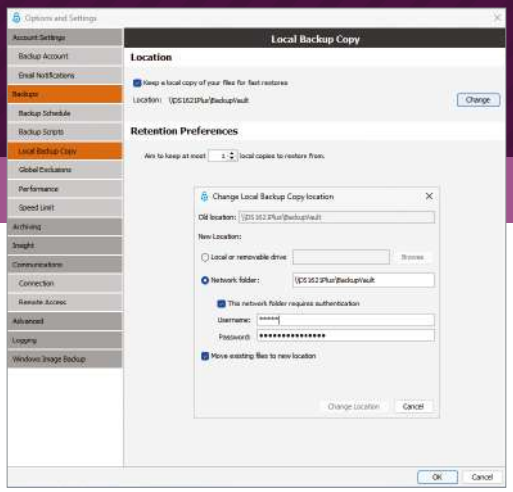
On-site backups offer instant access to data for quick restores and provide insurance against internet outages. Cloud backups ensure you can reach your data in situations where, for example, IT equipment gets stolen or access to your office is denied.

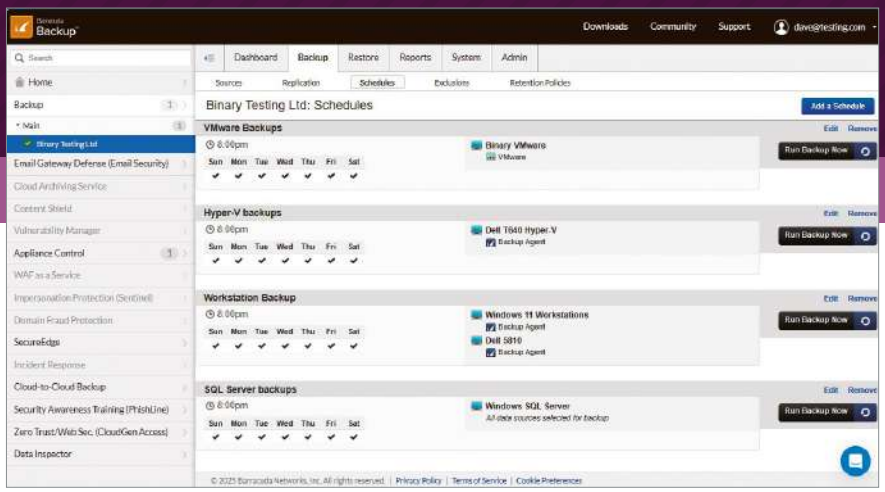


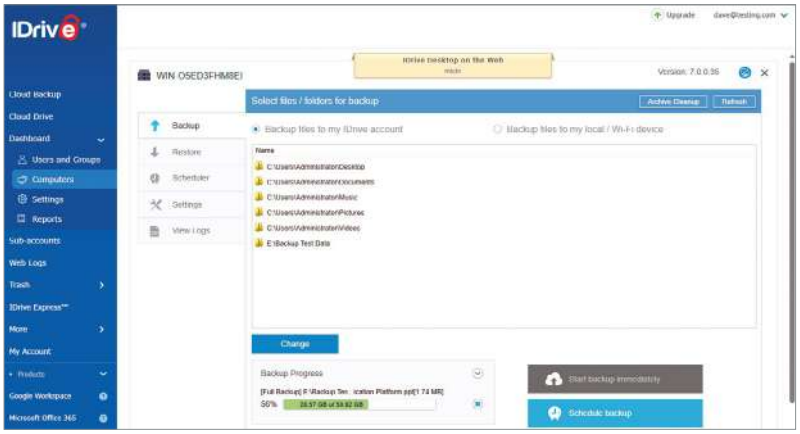

**BELOW** BackupVault Windows Server client offers a full system backup option

## Cloud costs

Before choosing a backup product, survey the systems and data you want to protect to determine how much storage you'll need. Most vendors offer capacity-based subscription services that include all required backup software, with many providing support for unlimited client devices.




**ABOVE LEFT BackupVault can run hybrid backups with local copies sent to a network share on a NAS appliance**

**ABOVE Barracuda automates backup strategies with its integral scheduling**

**LEFT IDrive is a great choice for backing up remote workstations and servers**

As your business grows, cloud capacity requirements will inevitably increase so check you can upgrade this on demand so you're only buying what you need, when you need it. Check also what capacity increments are available – one vendor is this guide allows you to increase capacity in 100GB chunks, while another offers a minimum upgrade of 1TB.

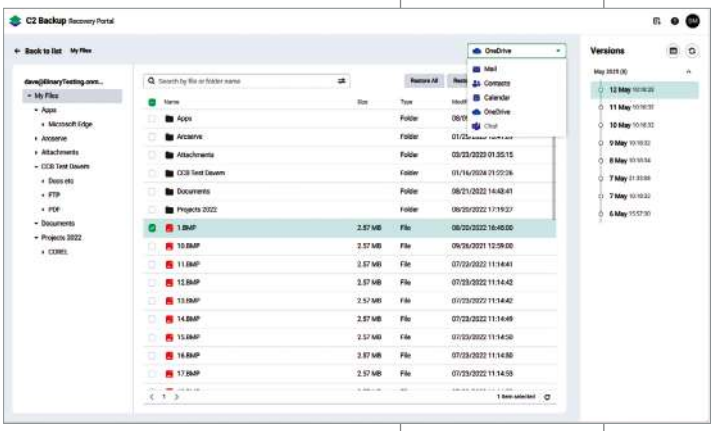
Data centre outages are fortunately becoming less frequent and severe, but if your provider does get caught out then your off-site backup copies will be inaccessible. For extra peace of mind, it's worth considering vendors that operate two or more data centres with built-in redundancy.

The only other decision you need to make is where to store on-premises backups. You should use a separate storage solution for this; NAS appliances are natural contenders for SMBs as they're inexpensive, available in a choice of sizes and support online capacity expansion.

## Ran$om demand

No business is too small to be of interest to cybercriminals. Backup products can't protect against attacks, but file versioning could mitigate them without you having to pay a ransom to get your data decrypted.

The best products let you choose the number of versions to keep going back days, weeks and months. If you get hit by a ransomware demand, it may be possible to restore files to a state before they were encrypted.




**ABOVE Along with workstations and servers, Synology includes cloud backup for Microsoft 365**

Don't assume your backup data is safe either, as the more sophisticated ransomware attacks gain access to the backup system and attempt to delete all backup copies before encrypting the source data. You should ask your prospective cloud backup provider what measures they have in place to prevent this.

Immutable cloud storage is a strong defence as once data is written to the cloud repository it can only be read and not changed, overwritten or deleted until a predefined retention period has expired. Some vendors offer "air-gapped" cloud storage that's isolated from the network and protected from attack, with one vendor in this guide providing a cloud recycle bin for recovering deleted data.

**"Immutable cloud storage is a strong defence as once data is written to the cloud repository it can only be read and not changed"**

## Automated flow

A data protection strategy that relies on human intervention is guaranteed to fail. Backup must be fully automated, so only choose products that provide full scheduling features allowing them to run jobs regularly without any manual input.

All four products on review will do this and also offer to manage an entire strategy comprising full, partial or incremental backups for each system. Full backups are just that, whereas partial backups only copy data that has changed since the last backup was run so are faster and more space-efficient.

To determine how often backups should be run, calculate your recovery time objectives (RTOs) and recovery point objectives (RPOs). RTOs determine the amount of time your business can comfortably survive without access to its systems, applications and data, while RPOs define the amount of data loss your business can tolerate.

An RTO in hours will require a backup strategy that delivers much faster restore services than an RTO measured in days. RPOs define the frequency of backup jobs – running one backup per day won't be enough if you can't afford to lose all the data created during the previous working day.

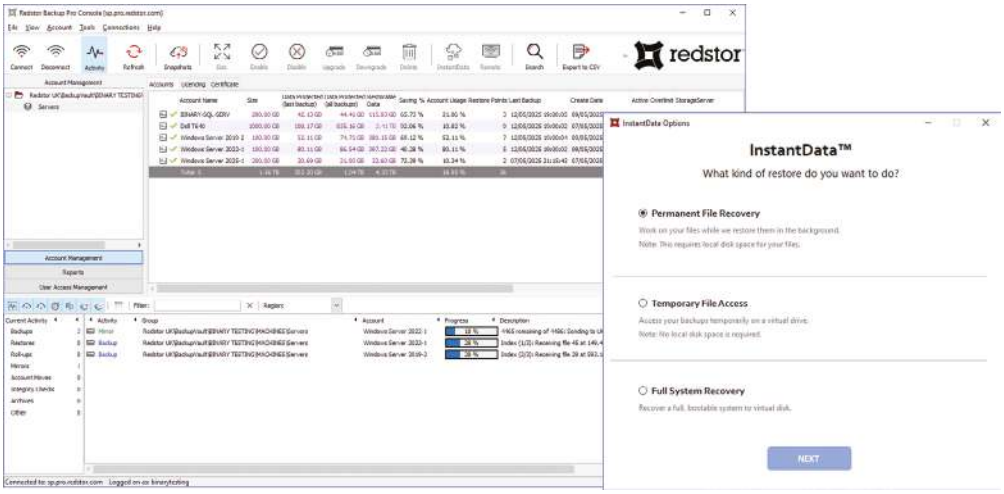
Once your data protection strategy is running smoothly, it's essential you regularly test all restore services. These will confirm that your backups are working, data is retrievable, your RTOs and RPOs can be met and any unforeseen problems are ironed out before you need to use them to recover from a real disaster.

# BackupVault Enterprise Server Edition

## A great hybrid backup choice for Windows server protection with smart recovery features

**SCORE** ★★★★½

**PRICE** From 50GB, £24 exc VAT per month from backupvault.co.uk




BackupVault will appeal to SMBs seeking predictable cloud storage costs as its prices are based purely on the total amount of data they want to back up. The company offers an extensive range of backup solutions, and the Enterprise Server Edition (ESE) on review is designed to secure physical, virtual and cloud-hosted Windows servers and hosted apps, with the price including support for unlimited systems.

Prices start at £24 per month for 50GB of storage, and you can increase this on demand in 100GB increments with substantial discounts applied when you go over 1TB. The price includes a rolling 30-60 day retention period for all file versions, with backups older than 31 days deleted on the first day of the following month. Longer retention periods can be requested, with 12 months costing an extra 10%.

Although BackupVault may seem expensive, a key feature that adds a lot of value is that it operates dual-redundant data centres in separate UK locations. Multiple copies of data are maintained across them, their storage is immutable and, even if a hacker does delete your backups, the company maintains a cloud recycle bin.

Deployment is swift: you install the BackupVault client on each server, which runs a wizard that requests a client name, an account password and an encryption key. Passwords and keys can be unique for each server, and you must document and securely store them as BackupVault cannot access them.

Businesses with multiple servers will love the free central management console app. This provides remote access to clients, along with system recovery and bare-metal restore services. It provides details of all servers and their backup status, along with facilities to instantly increase or decrease cloud storage capacity for each one.

From the client interface, you decide whether to back up selected local drives, folders, files and the system state, or enable the full system backup option. You can also add network shares to your backup selections – handy for securing NAS data.

Backup tasks can be run on demand or at regular intervals, and the client scheduler can run as many daily jobs as you want. Hybrid backups are a standard feature as the client automatically copies data to a secondary location; we used this to declare a share on the lab's Synology NAS.

**ABOVE** All server deployments can be remotely managed

When the client is installed, it discovers apps on the host and adds extra tabs for them in the backup selection window. For our Hyper-V host, we could add VMs to the backup schedule while on our Windows Server 2025 SQL Server host, it listed all databases as available for backup.

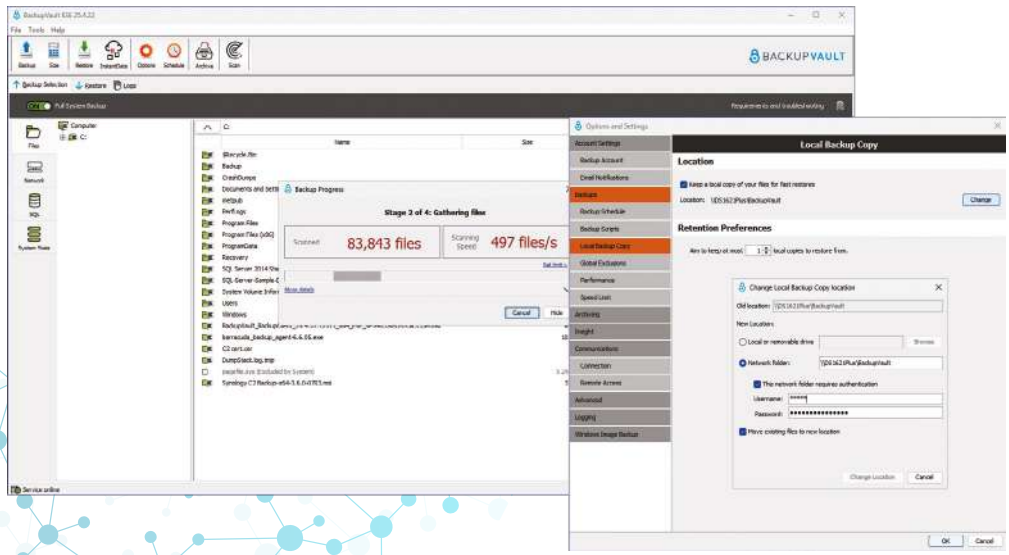
Recovery features are easy to use. We browsed local and cloud backups, chose a date, selected files, folders, Hyper-V VMs and SQL databases, tapped the client's restore button and decided whether to send them to the original or a custom location.

> **"Cloud storage costs are comparatively high, but the extra cash gets you unbeatable data centre security and availability"**

The smart InstantData feature reduces wait times for large file restores to seconds using a combination of sparse files and a proprietary kernel driver to service read requests so users can work on files as they are being restored. InstantData can restore data to a permanent location or create a virtual drive for temporary access, with the remote console also offering facilities to create a VM or a bootable system image for bare metal recovery from a selected backup.

Cloud storage costs for BackupVault Enterprise Server Edition are comparatively high, but the extra cash gets you unbeatable data centre security and availability. It's a top choice for Windows server backup, ongoing costs are easily managed, and the smart InstantData feature will appeal to businesses that want fast restore services.

**BELOW** The BackupVault client app provides a wealth of features, and jobs can include hybrid backups




**REQUIREMENTS**

Windows Server 2016 upwards

# Barracuda Backup Vx

## A hybrid backup solution that's ideal for SMBs looking to virtualise on-premises data protection

**SCORE** ★★★★★

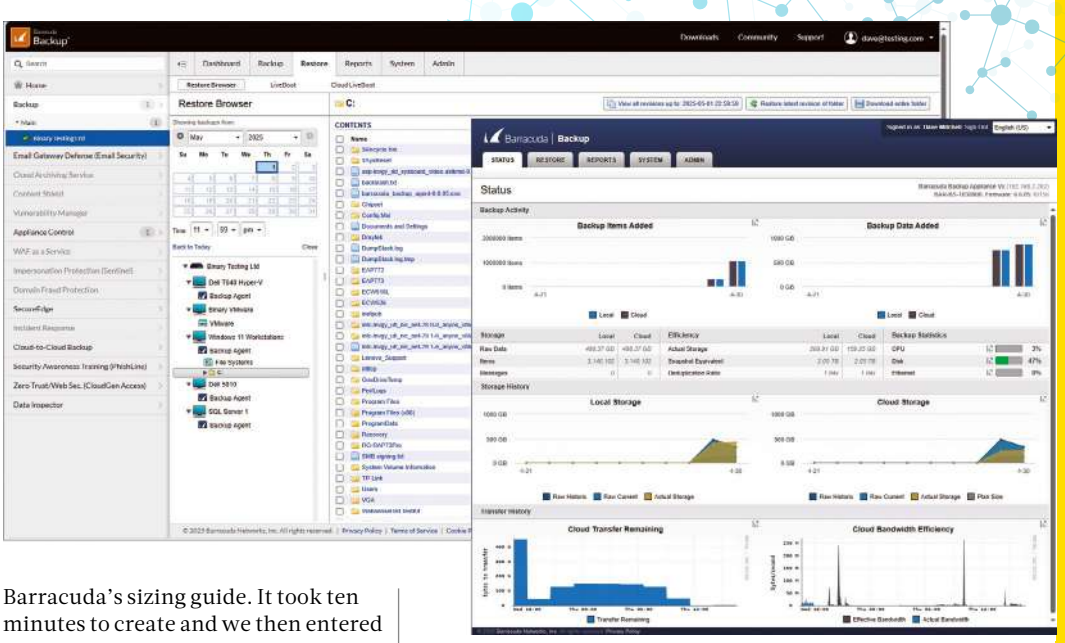
**PRICE** Starts from £804 exc VAT per year from barracuda.com

Barracuda's all-in-one backup solutions can look after all local and cloud backups, site-to-site replication and disaster recovery. Available as physical and virtual appliances, they can be managed entirely from Barracuda's cloud portal.

This year sees Barracuda launching a range of hardware appliances that have more on-board storage to avoid migrating to larger models when space runs low. New capacity-based subscriptions mean you no longer pay separately for the appliance and can increase storage as demand rises.

We reviewed the Backup Vx virtualised appliance, which has a different pricing model and is great value for businesses already using Hyper-V or VMware hosts. The appliance is free and there are no restrictions on local capacity: you simply expand its internal storage when required. You only pay for the systems to be protected and the amount of cloud storage required, with a single-socket licence costing £804 per year and cloud storage starting at £1,152 per year for 1TB.

We deployed Backup Vx to our Windows Server 2022 Hyper-V host, importing the VM template and assigning the appropriate memory and vCPU quantity as detailed in Barracuda's sizing guide. It took ten minutes to create and we then entered its linking code in our cloud portal account to register it.




**ABOVE** Barracuda provides great data recovery tools

Hosts and applications are then declared to the portal, which provides download links for small foot-print backup agents for Windows, macOS and Linux hosts. These take a few seconds to install and automatically encrypt communications between the host and appliance.

Declaring our VMware vCenter host required just its IP address and credentials. You have two options for Hyper-V. If you load the agent on the host it will run storage-hungry image-based VM backups, while loading it in each VM enables more efficient incremental backups and full protection for virtualised apps.

During backup task creation you assign sources to a schedule, with the default option automatically backing them up once a day. Multiple custom schedules can be created by assigning specific sources, browsing and choosing items to be protected and repeating jobs as often as every 15 minutes.

PC PRO RECOMMENDED

**"Barracuda's Backup Vx is a great choice for SMBs seeking an affordable virtualised on-premises backup solution"**

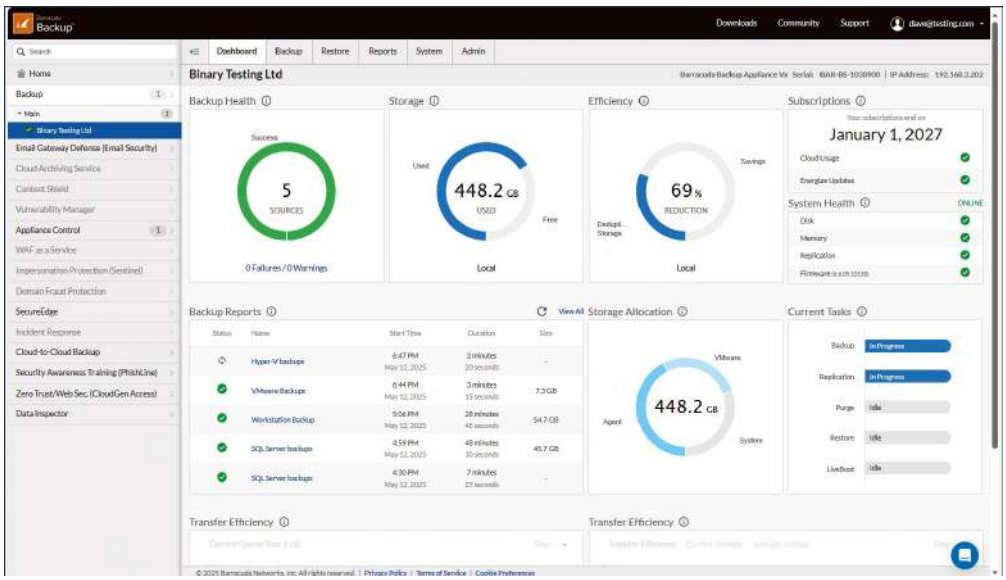
Cloud replication is enabled on selected sources simply by ticking a box. You can register other Backup appliances for site-to-site replication, and using secondary Vx appliances only as replication receivers is free.

The dashboard kept us in touch with all the backup action, and data recovery operations are a breeze. We could select systems from the restore browser, choose files, folders and SQL databases and recover them directly from the appliance or download them from our cloud repository.

Ransomware protection is present as Barracuda's immutable cloud repository is air-gapped. If you want to restore data from a previous time, the portal shows all available file versions. Sickly systems can be brought back to life by downloading the bare metal recovery kit from the portal and using it to recover them from the appliance.

VM recovery options are extensive and can be restored to the original host or another system, with the LiveBoot option restoring VMware VMs back to the host and using the appliance for datastore duties. The optional Cloud LiveBoot feature can run them in the cloud repository for up to seven days and the appliance offers a local web interface for restore and LiveBoot operations in the event of an outage.

Barracuda's Backup Vx is a great choice for SMBs seeking an affordable virtualised on-premises backup solution. It's easy to deploy on VMware or Hyper-V hosts and seamlessly integrates local and cloud backup.




**BELOW** The Backup Vx appliance is remotely managed from the Cloud Control portal

### REQUIREMENTS

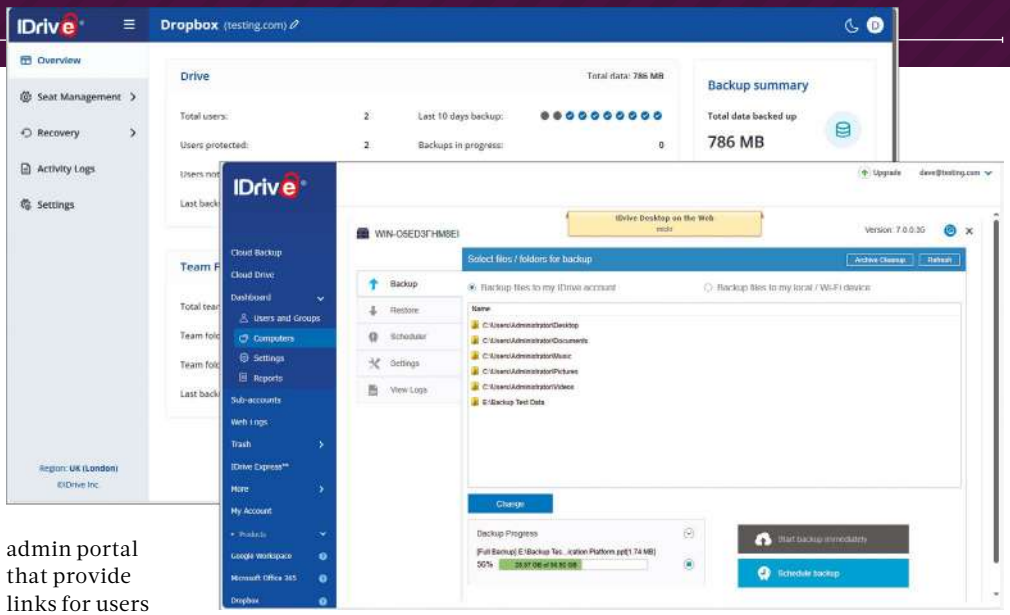
**Host:** Windows Server Hyper-V 2012 upwards; VMware ESXi/vSphere 7 upwards.
**Clients:** Windows 10, Server 2012, macOS 11 upwards, Linux

# IDrive Business

## This smart hybrid cloud backup service has top platform support and is perfectly priced for SMBs

**SCORE** ★★★★★

**PRICE** 5TB, £791 exc VAT per year from idrive.com




SMBs seeking a cloud backup provider that is totally transparent about pricing will love IDrive Business. Simply choose the amount of cloud storage you want and everything else is included with no hidden costs.

IDrive Business starts at £53 per year for 250GB, increasing to £791 for 5TB if you pay yearly, and you can easily upgrade cloud capacity on demand. You can protect as many systems as you want up to your cloud storage limit, and platform support includes Windows workstations and servers, macOS and Linux desktops, iOS and Android mobiles, Hyper-V and VMware virtualisation hosts, as well as Exchange, SQL Server, SharePoint and Oracle business apps.

IDrive introduced optional cloud-to-cloud (C2C) backup services for Google Workspace and Microsoft 365 (MS365) last year, and it's now added support for Dropbox and Box. Priced per seat and including unlimited storage, the services are enabled from your main cloud portal and offer a choice of five global data centre regions.

The IDrive desktop client has a substantially redesigned interface providing easier access to all features. Deployment is swift: email invitations are sent from the admin portal that provide links for users to create backup accounts, select AES-256 encryption and download their personal desktop app.

The app creates a default backup set for common files and documents, which can be modified by adding or removing items to be protected and creating regular backup schedules. IDrive will appeal to businesses with remote workers as admins can access their desktop app from their own portal, create or edit backup jobs, set schedules and run restore tasks.

IDrive is geared up for hybrid backups as you can create jobs to secure data to local drives, network shares and cloud storage. You can't use one job for them all as you create an online job for cloud backup and a separate one that points to a local folder or network share.

There are plenty of additional features, too: IDrive provides apps to protect Qnap and Synology NAS appliances, and supports disk image backups, cloning and continuous data protection (CDP) for file sizes up to 500MB. File versioning is included, with IDrive able to retain up to 30 versions. The extra copies have no impact on your cloud storage quota.

**ABOVE** IDrive now supports Dropbox C2C backups

PC PRO A-LIST

**"IDrive Business is an incredibly affordable hybrid backup solution for SMBs. It's easy to deploy and use, and is ideal for protecting on-premises and remote systems"**

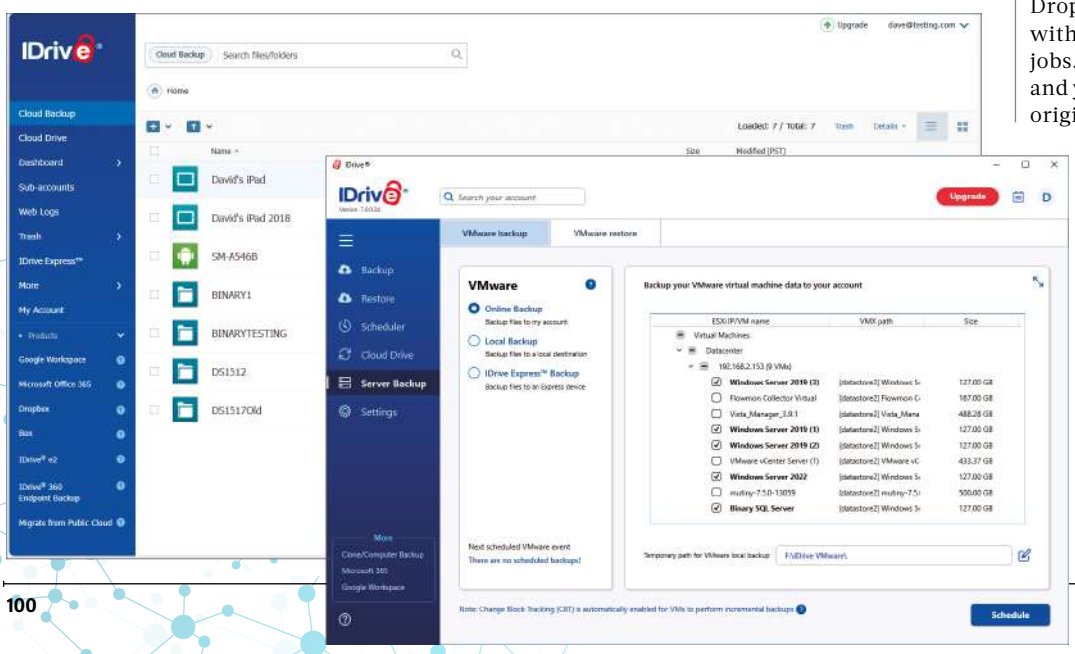
Backing up Hyper-V virtual machines requires the client loaded on the hypervisor host, while jobs for VMware VM backups can be created from any IDrive client app on the same network as the ESXi or vCenter host. When restoring VMs, IDrive requires access to the local backup folder, or you can use the standard restore service from the client app or portal to copy it back from cloud storage.

For file and folder recovery, you can use the web portal or client app to view your cloud and local backups, browse them and select the data to be restored. Where multiple versions are present, you can choose the one you want from the list. In all cases, items can be restored back to their original location or another folder.

The new Dropbox C2C service is accessed from the main IDrive console, presents a dedicated portal and automatically backs up registered personal and business Dropbox accounts three times a day, with options to run extra manual jobs. File and folder recovery is swift, and you can send items back to the original user or another account, with IDrive's non-destructive restore process placing them in newly created folders.

IDrive Business is an incredibly affordable hybrid backup solution for SMBs. It's easy to deploy and use, supports an impressive range of platforms, and is ideal for protecting on-premises and remote systems.

**BELOW** IDrive has a user-friendly portal and a redesigned desktop app interface




### REQUIREMENTS

Windows 7, Server 2012, macOS 10.13, iOS 13, Android 7 upwards • VMware ESXi/vCenter 6.5 upwards

# Synology C2 Backup for Business

## A secure backup solution that teams up unlimited device support with MS365 protection at a good price

SCORE ★★★★☆

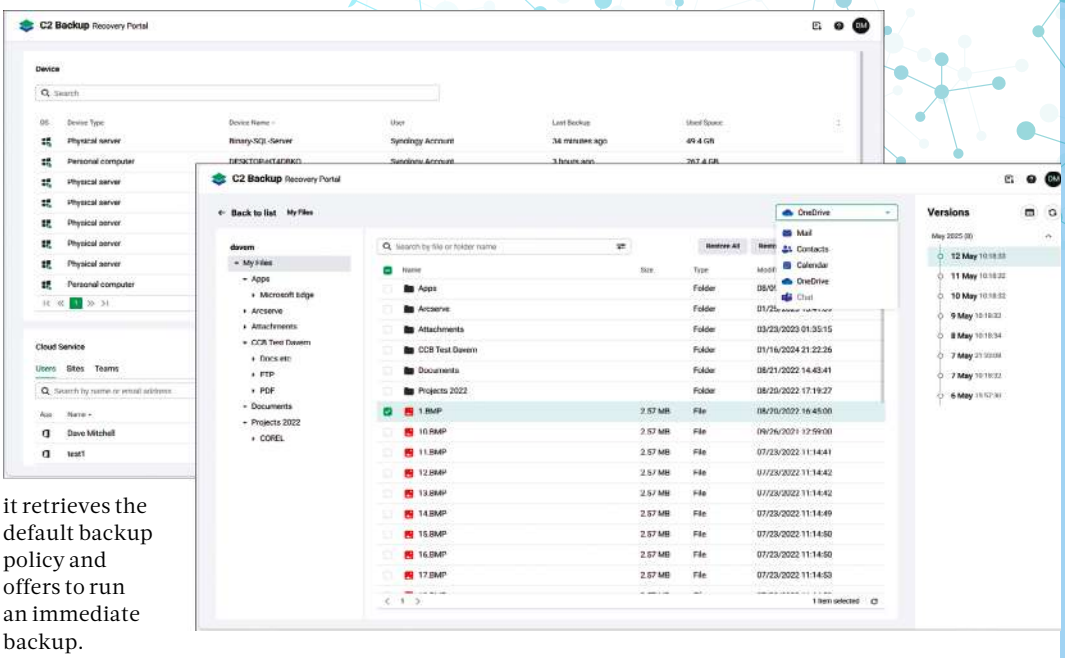
**PRICE** From 5TB, £423 exc VAT per year from synology.com

Best known for its highly respected NAS appliances, Synology also offers a range of cloud backup solutions. C2 Backup for Business provides simple, easily deployed cloud backup and data recovery services with no on-premises hardware requirements.

The starting price of £423 per year gets you a big 5TB chunk of cloud storage, with 1TB increments costing a further £101 per year. It supports unlimited Windows and macOS devices and includes cloud-to-cloud (C2C) backup services for all four Microsoft 365 (MS365) components, with the Business plan protecting up to 250 users and 50 teams.

During account setup, you select a Synology data centre and enter a unique domain name, which provides secure access to users of the backup service. Next, you enter an encryption key to authenticate access to all Synology C2 cloud services.

Ensure you securely document the key as Synology has no access to it. If you forget it, the deployment process generates a 48-character recovery code, which should also be kept safe. To add devices, you download the appropriate agent from the portal and, after logging into your cloud account, it retrieves the default backup policy and offers to run an immediate backup.




ABOVE **A separate recovery portal is used to restore selected items**

The portal lists all protected devices and places workstations and servers in separate groups. A base set of backup policies is provided which can be edited or cloned and used as a basis for custom policies.

Policies can be set to secure entire systems, the boot and systems partitions or specific volumes. Automatic and custom policies only backup devices once per day but you can run manual backups on demand, apply custom retention rules and enforce upload rate limits.

The main drawback with the service is that it can't manage a 3-2-1 backup strategy as there are no facilities to run backups to on-premises storage. Businesses invested in Synology NAS appliances could use DSM's free Active Backup for Business app for local backups but this does complicate matters as you'll be using two separate products to maintain full protection.

Adding our MS365 account was easy. After a two-step authentication process, we could decide which components to protect. One default backup policy is provided, which can be modified to include or exclude Exchange mail, contacts and calendar, OneDrive, Chat, SharePoint sites and Teams.

MS365 backups are run once a day, and you can decide to retain all versions or keep them for a specific number of days, with the auto-protection feature searching for new MS365 objects each day and adding them for backup. MS365 recovery is handled well: you select a user, choose the desired component from the drop-down menu and decide whether to download items or restore them back to their original location or another folder.

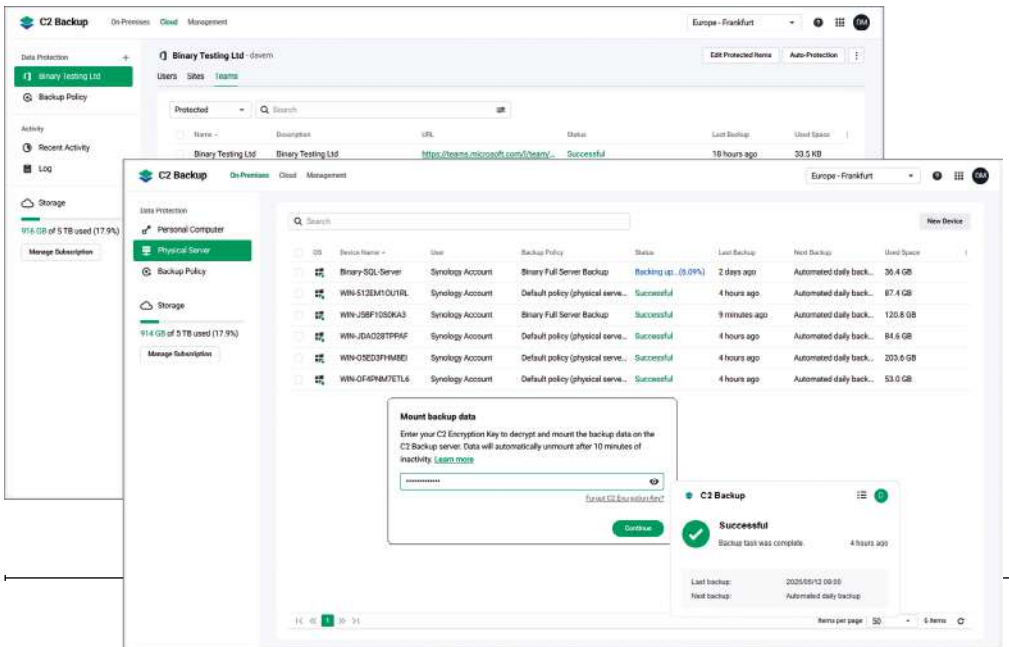
> **"Boot a sickly system with the recovery media and it will connect to your account and restore the system from the cloud"**

For general data restore operations, you choose a device, select a recovery point and view its contents in the self-service portal. This can be accessed directly on protected devices from their system tray icon. In all cases, selected files and folders are sent to the system's download folder.

Bare metal recovery is available, with the portal offering to create bootable recovery media for the selected system on a USB stick or as an ISO. Boot a sickly system with the recovery media and it will connect to your account and restore the system from the cloud.

Synology's C2 Backup for Business will appeal to SMBs that want simple cloud backup at a very good price. You may need to consider the extra cost of implementing a 3-2-1 backup strategy but the service is easy use and the price includes integral MS365 protection.

BELOW **Server, workstation and MS365 backups are all managed from the same web portal**




### REQUIREMENTS

Windows 7, Server 2012, macOS 10.15.7 upwards ● Microsoft 365 Business

# TP-Link Omada EAP725-Wall

## Modest performance, but this dual-band Wi-Fi 7 AP delivers lots of easily managed features in a palm-sized package

**SCORE** ★★★★☆

**PRICE** £100 exc VAT
**from** broadbandbuyer.com

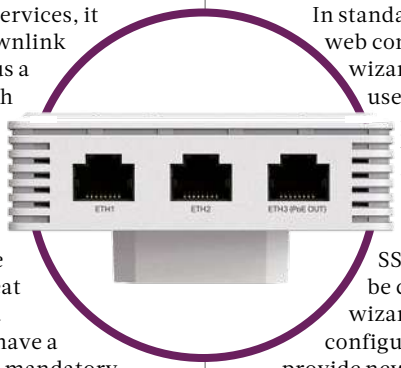
TP-Link offers an extensive range of discrete wall-mounted wireless access points (APs), and the EAP725-Wall brings Wi-Fi 7 services into play. Designed for environments such as meeting rooms and hotels looking to provide in-room network services, it has two gigabit downlink ports in its base plus a 2.5GbE passthrough port that provides PoE, allowing it to power extra in-room devices such as IP phones.

At only £100 the EAP725-Wall is great value, but there's a catch as it doesn't have a 6GHz radio. It isn't mandatory for Wi-Fi 7 APs to have this, though, and many other vendors are also offering low cost dual-band models.

This BE3600-rated AP offers two spatial streams each for the 2.4GHz and 5GHz bands and claims maximum speeds of 688Mbits/sec and 2,882Mbits/sec respectively. The US version has a higher BE5000 rating as it supports the 5GHz 240MHz channels.

It may only be a dual-band AP, but the EAP725-Wall offers plenty of Wi-Fi 7 features including 4K-QAM (quadrature amplitude modulation) and multi-RUs (resource units). The latest firmware version adds support for MLO (multi-link operations), which allows compliant wireless devices to connect over an aggregated link using both bands.

Measuring only 40mm thick, the EAP725-Wall is clothed in a sturdy polycarbonate casing with an aluminium inner shell. Its main 2.5GbE LAN port lurks at the rear and the AP is installed by unclipping the front panel and screwing it into a wall junction box.




In standalone mode, the web console's quick start wizard requests a new username and password, after which it removes the default admin account for extra security. Eight SSIDs per radio can be created, and the wizard asks you to configure the first two and provide new encryption keys.

With the AP hooked up to the lab's Zyxel XS1930-12HP 10GbE PoE++ switch, we ran performance tests using a Lenovo Windows 11 Pro desktop client equipped with a TP-Link Archer TBE550E Wi-Fi 7 PCIe adapter. Starting with Microsoft's NTttcp utility, we recorded modest raw TCP upstream and downstream speeds of 204MB/sec and 175MB/sec.

Our real-world large file copies between the client and a Windows server on the 10GbE LAN averaged close-range speeds of 181MB/sec, dropping to 160MB/sec with the AP moved ten metres away and into an adjoining room. With MLO enabled, the client reported an aggregated link speed of 3,570Mbits/sec, but further tests showed no performance gains.

When it comes to remote management, you can choose from TP-Link's hardware and free software on-site controllers or use its cloud-based versions. The latter has extra appeal as TP-Link offers a free Omada Essentials cloud controller, which provides a base set of management and monitoring features for smaller businesses.

**ABOVE** The sturdily built EAP725-Wall is easy to deploy and manage

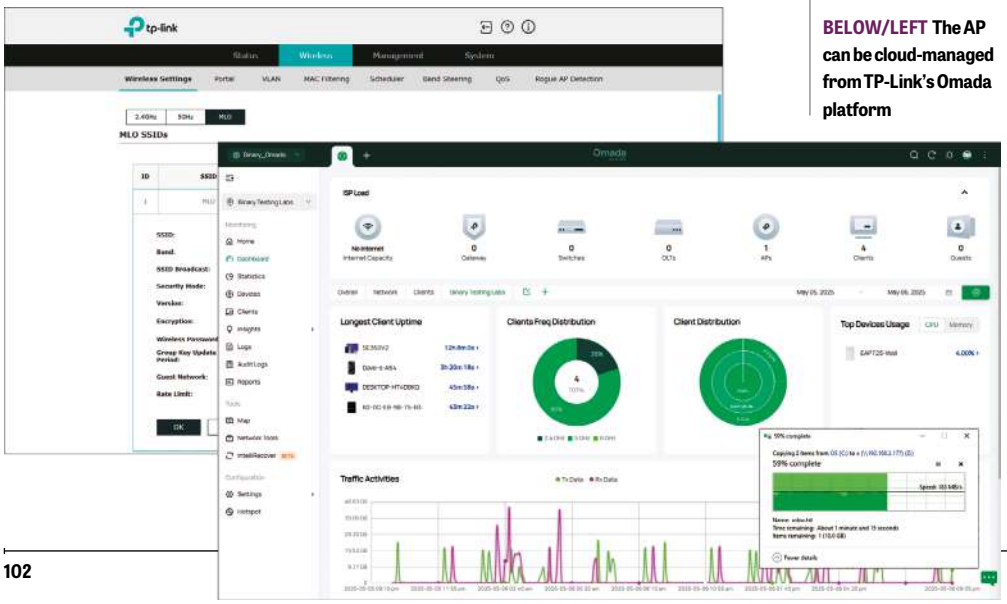
**LEFT** There are two 1GbE ports and a single 2.5GbE passthrough port on the rear

We used the Standard cloud controller, and its dedicated web portal presented a customisable dashboard and an upper ribbon showing internet capacity, gateway usage, switches, APs, clients and guests. To manage the EAP725-Wall, we used the Omada iOS app to scan the QR code on its base, add it to our site and assign a cloud licence.

The cloud portal supports the same number of SSIDs as standalone mode, and you can easily create new ones and apply encryption schemes and rate limits. Cloud management enables many extra features as wireless coverage can be extended using meshing, any SSID can be set as a guest network with L2 isolation and captive portals assigned to selected SSIDs by creating profiles using a range of authentication methods and customised portal splash pages. The AP's three extra ports are also accessed from the cloud portal, and if you use PoE+, the 2.5GbE passthrough port will provide 7W to a PD (powered device), whereas a PoE++ source ups this to 15.4W.

**"The EAP725-Wall is a compact and affordable Wi-Fi 7 solution ideally suited to environments such as meeting rooms and hotels"**

The EAP725-Wall is a compact and affordable Wi-Fi 7 solution ideally suited to environments such as meeting rooms and hotels. Wireless performance is underwhelming but it's simple to deploy and manage, and the three downlink ports add extra versatility. **DAVE MITCHELL**




**BELOW/LEFT** The AP can be cloud-managed from TP-Link's Omada platform

### SPECIFICATIONS

BE3600 dual-band 2.4/5GHz 802.11be access point • 4 x internal aerials • 2.5GbE LAN/802.3at PoE+ • 3 x download ports (2 x 1GbE, 1 x 2.5GbE/PoE out) • 86 x 40 x 143mm (WDH) • 366g • limited lifetime warranty

# UnifyDrive UT2

## Perfect for mobile users, the UT2 puts a fully featured NAS device in your pocket with a connection for every occasion

**SCORE** ★★★★½

**PRICE** Diskless, £398 exc VAT
**from** unifydrive.com

UnifyDrive takes NAS to the next level with its all-Flash UT2, the first we've seen that's truly portable. Not much larger than a smartphone, it packs in an incredible hardware package making it ideal for mobile workers that need a fast storage device they can use in the field for file sharing, photo backup, storing documents and much more.

It has two PCIe 3 slots for M.2 NVMe SSDs and is driven by a powerful Rockchip RK3588C CPU that presents four 2.4GHz A76 plus four 1.8GHz A55 cores, all served by a quiet internal fan. There's 8GB of soldered DDR4 memory and an ARM Mali-G610 GPU that pipes 8K video to the HDMI 2.1 port, with the supplied Bluetooth remote handset used to control viewing.

Connection options abound, with network services handled by a 2.5GbE multi-gig port and an integral Wi-Fi 6 adapter that functions as a client or access point. You have USB-C 3.2 Gen 1 with DisplayPort and USB-A 3.2 Gen 1 ports, while photographers on the go will appreciate the SD and CFexpress (CFe) B card slots.

LEFT **The UT2 is a portable NAS device that's no bigger than a smartphone**

A dedicated USB-C port handles power input, although you'll need a UK adapter as the supplied power block is the US 2-pin variety. The UT2 has an internal battery, but this is designed primarily for UPS protection since it only has enough juice to keep it running for an hour at most.

Installation is simple. We hooked up the UT2 to the lab's 2.5GbE network and ran the UnifyDrive iOS app on an iPad. This discovered the device, ran a firmware update, registered it and asked us to create a new admin user and authenticate it by entering the six-digit code sent to the email address we provided.

We fitted a couple of Kingston M.2 NVMe SSDs and the routine offered to create a storage pool. You can use a single drive or select a RAID1 mirror for two but we chose the unique UnifyDrive Data Redundancy option, which combined the capacity of the two SSDs and allowed us to select folders we wanted mirrored across both drives.

You can use the mobile app to manage the UT2, while desktop and laptop computers have the Windows and macOS clients. All provide the same features, and on first contact, it becomes abundantly clear that the UT2 is a fully functional NAS appliance.

Web browser access isn't supported, but the Windows desktop client furnished us with full access to all features. Apps are provided for creating new users, setting up network shares, viewing photos and movies, configuring secure remote access and running cloud backups of local content to OneDrive. The Google Drive option is currently waiting for its API to be certified.

PC PRO RECOMMENDED

**"The UnifyDrive UT2 is a great pocket-sized storage partner for mobile users that's extremely versatile and packs a big punch"**

Press the button on the side and the PlugBackup app automatically copies the contents of inserted SD or CFe cards to your chosen location. The UT2 even has ransomware protection that scans for files such as Office documents and images, encrypts them and only allows access when the decryption key is provided.

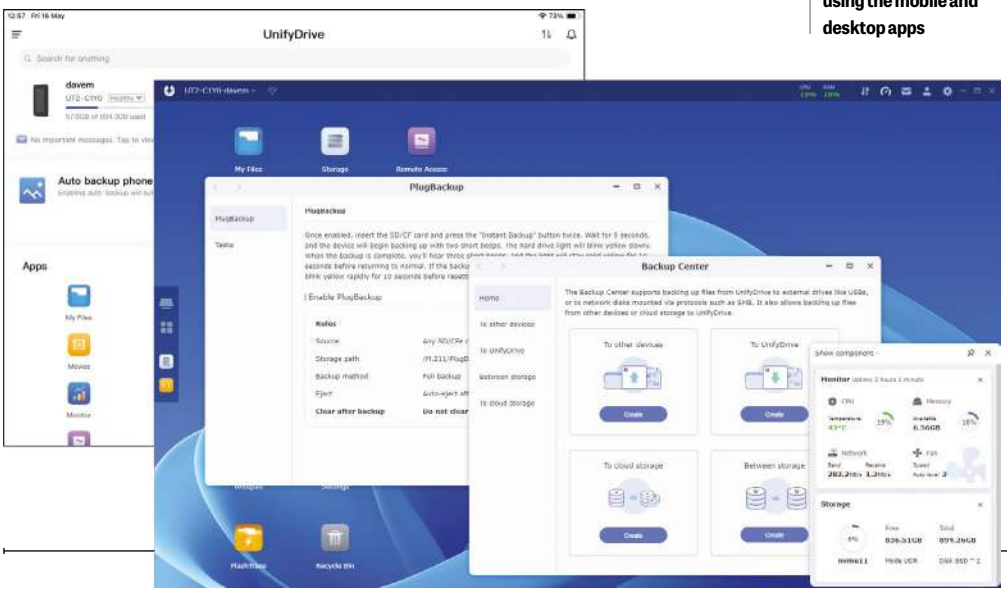
To test network performance, we ran Iometer on a share mapped over 2.5GbE to a Windows server host. It reported back with respectable raw sequential and random read and write rates of 2.2Gbits/sec and 1.5Gbits/sec.

We tested battery longevity and, under a light load, it lasted 63 minutes before the minimum 15% power threshold was breached and the device safely powered itself down. The battery took 110 minutes to fully recharge, and with a continuous heavy workload applied it mustered 47 minutes of runtime.

Internal battery life does limit field time, but we were able to extend this by six hours with a lightweight UGreen Nexode power bank. With this remedied, we can safely say that the UnifyDrive UT2 is a great pocket-sized storage partner for mobile users that's extremely versatile and, for the price, packs a big punch in the hardware department. **DAVE MITCHELL**

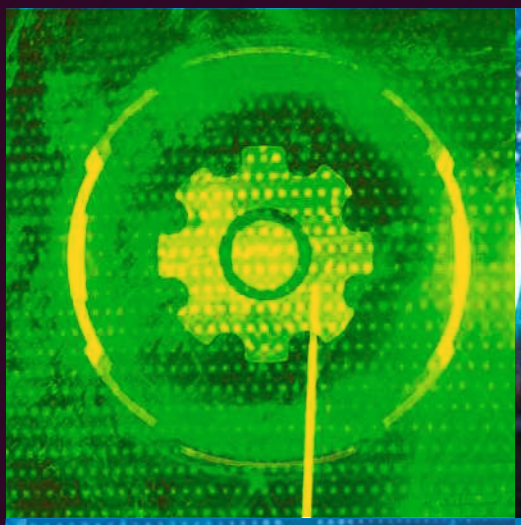
LEFT **Photographers will appreciate the SD and CFexpress B slots**

BELOW/LEFT **The UT2 can be easily managed using the mobile and desktop apps**




### SPECIFICATIONS

Portable chassis ● 8-core RK3588C CPU ● Arm Mali-G610 GPU ● 8GB DDR4 ● 32GB eMMC storage ● 2 x M.2 2280 NVMe PCIe Gen 3 sockets ● 2.5GbE ● Wi-Fi 6 ● Bluetooth 5 ● USB-C 3.2 Gen 1 with DisplayPort ● USB-A 3.2 Gen 1 ● CFexpress B ● HDMI 2.1 ● USB-C power-in ● 2-pin PSU ● internal battery ● 174 x 90 x 28mm (WDH) ● 306g ● 2yr hardware warranty



# The ins and outs of INVENTORY MANAGEMENT

**Your stock, and the data pertaining to it, are crucial business assets. Steve Cassidy dives into the IT challenges of managing it all**

Keeping track of what you own sounds like an innocent, even mundane subject. Those of us who were working in IT back in the last century may associate the phrase "inventory management" with afternoons spent among silver plastic sticky labels and long debates about whether a mouse was a consumable.

But to businesses built on shipping goods to customers, inventory management is a much bigger and more fundamental function. And it's no longer just about the physical items sitting on your shelves, but also the devices that process them and the data they generate in doing so.

**Ensuring you'll have the capacity to manage whatever tomorrow may bring is easier said than done**

**ABOVE** **Inventory management is often part of a larger ERP function**

**RIGHT** **Tiny IoT sensors can be very powerful, but they too need managing**

## ERP in depth

Inventory management is an old idea, but it ties in directly to the modern notion of enterprise resource planning, or ERP. This ambitious practice in effect takes in every reachable part of a computerised factory system, in pursuit of making the entire operation as logic-driven as possible, efficient with raw materials and energy, responsive to changes in client needs and, of course, legally compliant.

Setting up ERP is, by nature, highly intrusive. Doing it properly means interrogating and managing every type of movement, whether that's of cash, energy or product. And inventory management is a core function of it – not only in the sense of tracking what you own, but tracking what you intend to acquire.

In fact, ERP deals with two distinct classes of inventory management, which we can crudely divide into the traditional counting of items on shelves, and deeper tracking of raw materials, processes and sub-assemblies. Anticipating and automating the processes that keep everything on target is a perfect fit for industrial sector IT consulting and systems integration specialists.

Of course, ensuring you'll have the capacity to manage whatever tomorrow may bring is easier said than done; as the current US President has reminded us, you cannot possibly plan for every possible change in business circumstances. If you've ever wondered what the basic driving force is behind those interminable "24-hour sale" emails, that's a form of inventory management, reflecting the shifting volumes of orders and unpredictable blips in gadgets-per-day production rates at the factory.

## The inventory of IoT

Inventory management is a slow-moving area of development, with a degree of immunity to fads and trends. The same can't be said about the Internet of Things. This emerging, coalescing collection of pseudo-standards connects the simplest widgets to the general public internet. In the context of IoT, a "thing" is any device that can produce or receive information, from a reed switch on a garden gate up to the control suite of a tokamak fusion chamber.

IoT devices can be useful tools for inventory management, with their sensors and data-collection abilities, but the things themselves also need managing – and this can be tricky, for several reasons. One is that they can be physically tiny, located almost anywhere and operating with no human intervention.

IoT gadgets also bring up the scenario where managing the devices themselves is generally less pressing than managing the data they generate. Left to their own devices, these little gadgets will cheerfully fill up every disk in your data centre with reports, even in quiet weeks. You'll get a warning saying your storage is running low, and it's because of a billion messages from a sensor controller gadget, all saying "no problems detected". Good luck if you need to archive it all for seven statutory reporting years.

IoT devices also tend to straddle multiple categories within a data inventory. In the world they inhabit, the very concept of ownership becomes flexible. For example, your home heat-pump controller might have been put in as part of a package from your regional power supplier, but maintained by a local supplier of appliances. As the owner of the kit it controls, you'll naturally want to be able to see its statistics; so do the power suppliers, as part of their centralised supply management and fault rectification processes, and they also want to be able to delegate that work to the supplying subcontractor.

That's at least four different agencies requiring administrative access, and four distinct inventories where the network address, username and password of one tiny device will crop up. All those databases have to play nice; none can expect exclusive access to a sole blinking LED up a telegraph pole or rattling about in a shipping container. Similar complications arise with edge-computing devices – typically larger machines, ruggedised for industrial or exterior deployments, and equipped with enough horsepower to act as a local

device controller and collector of sensor data, for those times when cloud access isn't operating so well.

Some of the largest users of this type of boundary-crossing tech are IT businesses themselves, especially the ones that have hardware out in the field, connecting back to the factory from afar. I'm not just talking about 5G data centres and the like, but even simple-sounding propositions such as desktop printers. Several manufacturers have implemented an inventory-based business model, whereby the printer automatically places orders for replacement consumables based on the sensor data collected by the machine itself.

**ABOVE** It isn't just about tracking what you have, but projecting what you'll need in future

**While this may sound like a small-scale operation, the back end is anything but**

While this may sound like a small-scale operation, the back end is anything but. I remember a deep-dive presentation by the engineering team responsible for the infrastructure that received and processed the messages from all the printers they had sold. On their huge flow-diagram there was a big input arrow, labelled PIGEON. I asked about this and was told: "That's the module that brings in data from the printers. We call it pigeon because it's inedible, it won't be easily tamed, and it flies in at random and poops data all over our servers, just when we don't want it to."

## Make a success of inventory management

**If you want to implement a new inventory-management project, you'll probably want to get external help involved. Bear in mind that the more powerful and wide-reaching you want it to be, the more tightly it will be bound to the specifics of your business. As always, you'll need to be ready for some debate and self-examination regarding your processes and goals – although hopefully that will help illuminate what you really need, and how to achieve it. Here are some points to consider:**

### 1 Opinions matter

Once you start looking for a partner in inventory or data-management, you'll undoubtedly be on the receiving end of some heavy-duty sales pitches, perhaps the heaviest-duty you've ever seen. There are lots of implementation consultants out there offering some very powerful and expensive products, which may or may not be massively over-specified for what you need to achieve.

Naturally you should explore your product options, but it's also vital to work with a reputable contractor. One relative newcomer client of mine saw a support agent completely trash their decade-long database of stock and buying trends in the course of a "routine" update and tidying process. The software supplier ended up having to write an apologetic letter to the tax authorities, explaining that their software was the reason why the customer couldn't complete that year's tax return.

The best route to gathering opinions is to join any industry associations or clubs you can find: most of the major software solutions will have user interest groups, where the usual rules of commercial confidentiality get a bit of a rest, and you can often find candid opinions on the pros and cons of the software, and any partners offering it. Always try your hardest to find a fair assessment of what you're getting yourself into.

### 2 Get everybody on board

Implementing a new inventory-management platform is definitely a "no passengers" situation: keeping your production line fed and working efficiently can make or break a company. The expansive, internet-facing style of inventory management effectively moves the prime focus of your business out of the factory and into the marketplace, putting heavy reliance on your systems to take up a role at the heart of your business.

This means that every last employee, professional service and even government regulator needs to know exactly who you've called in, what you're asking them to do, what their estimated completion dates are, and anything else they care to mention. It's one step back from the biggest things you can do to a business, like a merger or takeover; there's just no way you can make this into a small and private project.

### 3 Start small

Despite what I've just said, you don't need to go big right from the outset. In fact, doing so is asking for trouble. This is an area where it makes sense to trial small prototypes, to develop an empirical, real-world sense of your needs and discover any obstacles while the stakes are low. As they say, "fail early, fail often – you learn a lot more from mistakes in small-scale projects than you do from the ones that are too big to be allowed to fail.

Of course, you can start with an ERP suite or inventory database of just one or two product lines, and bring across a limited number of departments ahead of the main body of the business. But you'll find a limited migration very quickly becomes a major one, with data sizes ballooning – and trying to run a new system in parallel with whatever you were using before can be more troublesome than making a wholesale switch.

### 4 Let the schedule slide

Time takes on a strange, shadowy aspect when it comes to inventory management. While some software offerings are designed to take advantage of modern, powerful server platforms, you basically want a system that's going to trundle along, in a boringly stable fashion, for as long as possible. This is where those "LTS" releases of Linux server

software have a natural home; the last thing your little sensor packages or smart re-ordering printers need is for their home reporting server to chop and change its network presence, go down or require replacement due to expiration of support.

Indeed, it's wise to take a slow, progressive approach to all aspects of planning and implementation. A wide-ranging inventory management project, by its nature, will require a near-total disclosure of everything your business does – much of which will never have been explicitly collected or codified before – so there's every chance that you'll make unexpected discoveries that cause the timetable to slip.

And be in no doubt, that's better than the alternative. Truthfully, the whole idea of an implementation timetable is a hiding to nothing when it comes to working at a large scale such as this. Setting hard deadlines might suit the accountants and the lawyers, but your task is to put in place a main pillar of the company's operations, of the IT investment, and of how customers work with you and perceive your ability to service them without constant on-site human presence. Those are some big promises to be making, and messing any of them up for the sake of losing a week or two – just to hit an arbitrary date that might have been selected 18 months beforehand – is simply self-destructive.

**You want a system that's going to trundle along, in a boringly stable fashion, for as long as possible**

## 5 Learn from the big guys

My last recommendation may be a by-product of the long contact I've had with the telecommunications business, but it certainly extends more generally. To me, it's not just a project rule but a useful insight into corporate relationships, and how they can be established and defined, at a fundamental level, by inventory-management procedures.

Let me explain: in the UK telecoms industry there are a lot of smallish companies that supply business phone systems. By every appearance these are independent operations, wholly separate from BT or any of the other backbone service providers. They have their own headed paper, distinctive product lines and different specialisations in fields such as call centre software packages or CRM.

Yet organisationally, many of these resellers barely exist at all. Most or all of their offerings are in reality repackagings of elements of BT's business-to-business services. This allows them to guarantee that BT will be able to support installed equipment, respond to malfunctions and the like. Metaphors involving bizarre insect life-cycles clinging to the belly of their partner spring, unbidden, to mind.

What makes all this possible is inventory management – in a broad sense, where inventory includes services as well as material goods. And the truth is that many businesses I've worked for or consulted to have been large enough to work in a similar way, had they chosen to do so. It's worth thinking about.

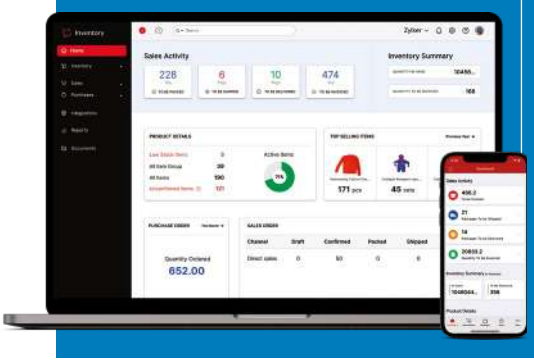
Then again, this model works particularly well for the telecoms marketplace, where the nature of the infrastructure imposes a certain degree of uniformity. The more diverse your industry, the more problematic this option can become. Implementation becomes a barrier: we're all used to the idea of migrating cloud services from provider to provider, but few people ever airily discuss switching their inventory management platform. It's a huge project that will necessarily transform the way your business operates, so is not one to be embarked upon lightly. ●

## Where to start with inventory management

**Not all businesses need an inventory management system, but if you're shipping physical products at any scale then it's a necessity. Here are three popular choices to kick off your search:**

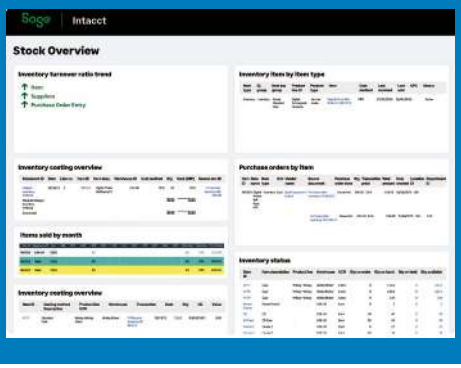
### Zoho Inventory

Smaller businesses will love the fact that Zoho Inventory is completely free for up to 50 orders per month; bigger plans start at £25 per month for up to 500 invoices and 300 purchase orders. A web-based portal is provided for both vendors and customers – and naturally it integrates with Zoho CRM, so if you're already using that platform it's an obvious choice.
**tinyurl.com/371zoho**



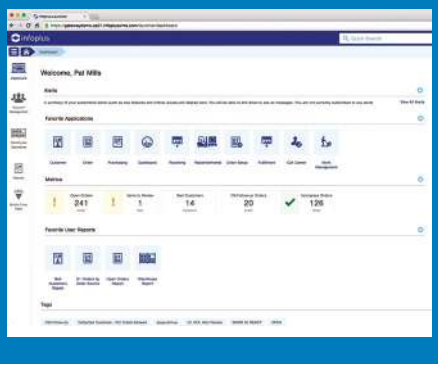

### Sage inventory management

Sage is best known for its accounting solutions, and its inventory management package integrates with financial software for a highly efficient workflow. It also has an emphasis on automation, with programmable stock alerts and reordering, along with demand-planning features and an AI assistant to help you make sense of the figures.
**tinyurl.com/371sageinventory**




### InfoPlus

InfoPlus is a large-scale solution that's particularly suited to big warehouse operations. The sort of companies it's aimed at can't afford downtime, so InfoPlus prioritises fast, friendly deployment, with a dedicated onboarding team and migration of existing data included in the service. It can even help with optimising your warehouse layout for quicker fulfilment.
**tinyurl.com/371infoplus**



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# Real world computing

Expert advice from our panel of professionals

JON HONEYBALL

## "Apple's headset still delights me, one of the few products that has the capability to make me gasp in wonder"

**In a month where Wi-Fi 7 starts to deliver on its promises and a six-year-old Mac mini listens to its master's voice, only one thing irritates Jon – and it isn't his Vision Pro**

I am getting increasingly annoyed with companies that make it difficult to update their software. Ideally, an app should have a "Check for update" menu item. Even better if there's a "Check every day" switch as well, so I immediately get informed of an update.

It's common in the high-end test equipment world for such downloads to require a login to companies' sites. Sometimes access is limited to those on an ongoing support contract, so that makes sense. I have to log in to Audio Precision (**ap.com**) to access the latest software for my APX517 or to Audiomatica (**audiomatica.com**) for its CLIO audio analyser.

But for mainstream software, this login requirement is just a bind.

It gets worse when the company involved makes the process actively hostile. Take, for example, VMware Fusion, VMware's hypervisor for macOS, similar to Parallels Desktop. Imagine my surprise when I chose "Check for Updates" and was presented with a "Software update/Checking" page, and then a pop-up box saying: "The update server could not be resolved. Check your internet settings or contact your system administrator."

Naturally, I had a long, hard word with myself. And decided that there was nothing wrong with my internet settings, either for myself or for my computer.

Then I stumbled across an article on Broadcom's knowledge base (**tinyurl.com/371vmware**) that said: "The product update feature is no longer available in VMware Workstation, Player, Fusion and VMRC. On clicking the Check for Updates option, an error stating Update Server could not be resolved will be presented." And then: "Moving forward, updates will need to be manually downloaded from the Broadcom Support Portal."

Why the dialog itself couldn't tell me this simply shows how little care there is for this product by Broadcom, the new owners of VMware. It wouldn't be so bad if the Broadcom support site wasn't such an unmitigated and hostile disaster. Wrestling an angry alligator is preferable to using that site.

It could, of course, update the app so that it doesn't throw this error; I'm running v13.6.3 (24585314), and that's the current version according to the support site. It was released on 4 March, so Broadcom isn't exactly falling over themselves to fix this. Did I mention I was getting annoyed?

### Vision Pro headband

The Vision Pro platform has reached the final release of version 2.5, and things are now on hold pending WWDC in a few weeks' time where v3 is expected to be unveiled.

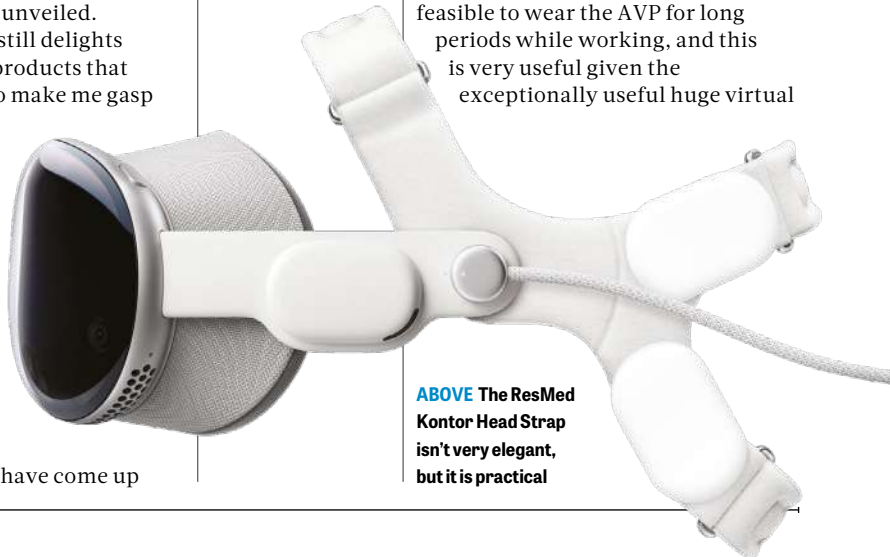
Apple's headset still delights me, one of the few products that has the capability to make me gasp in wonder, but the headband's design has always been a compromise. Apple ships an adjustable band that goes around the back of your head; adequate, but it ends up clamping your head between the front and rear. Various companies have come up with upgraded headbands, but I was intrigued when I saw that ResMed is making a serious three-strap head band. I know ResMed well, using its CPAP machine every night, and it certainly knows how to get items to fit onto your head for extended periods of time.

**Jon is the MD of an IT consultancy that specialises in testing and deploying kit**
**@jonhoneyball**

**"Wrestling an angry alligator is preferable to using the Broadcom support site"**

The ResMed Kontor Head Strap is neither cheap (£120 from the Apple store) nor elegant, but it is eminently practical. There are three bands of adjustment so positioning isn't a problem, but most interestingly it comes with a set of small weights that you can Velcro onto the bands. This allows you to completely change the balance of the Vision Pro on your head. I have found this a significant improvement during the longer wearing periods I have with the AVP, and most importantly it allows me to relax the pressure on my face of the AVP itself.

The Vision Pro is far from being an invisible "hover in front of me" device, something we will surely have to wait several generations for, so the ResMed Kontor Head Strap is a great addition as an interim measure. For me, it has made it feasible to wear the AVP for long periods while working, and this is very useful given the exceptionally useful huge virtual



**ABOVE The ResMed Kontor Head Strap isn't very elegant, but it is practical**

**Jon Honeyball**
Opinion on Windows, Apple and everything in between – p110

**Lee Grant**
Tales from the front line of computer repair – p113

**Olivia Whitcroft**
Lawyer Olivia offers legal advice for the tech industry – p116

**Davey Winder**
Keeping small businesses safe since 1997 – p118

**Steve Cassidy**
The wider vision on cloud and infrastructure – p122

desktop I can project in front of me when working at home. Here in the lab, I have two 27in 5K screens. The AVP gives me more than that and does so in a way that's very home-friendly when tidying up for dinner.

So the ResMed Kontor Head Strap gets a definite thumbs up from me. The cost is a little high, but the design and implementation are worth it, and if helps you spend more time with your £3,500 AVP then it's surely a worthwhile investment.

## Building a wireless bridge

I've decided to give up one of the warehouses we have in Huntingdon. Becki, who runs our stores, has done a magnificent job of getting stuff sent back to clients by the pallet load. It's quite worrying how quickly "stuff" can accumulate when you have the space available to be used.

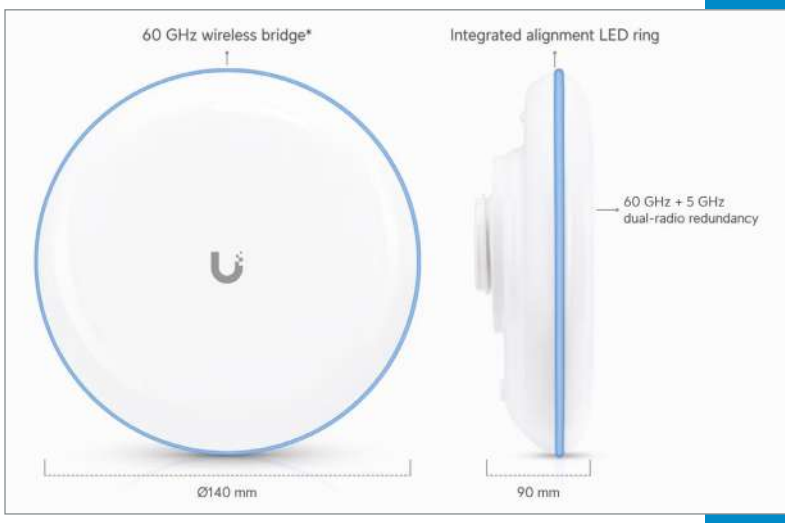
This has precipitated a rethink on the connectivity we've been using on that unit. It's next door to another warehouse that we also use, and so feeding IP from one building to the other was simply a case of running an Ethernet cable. Over the yard we have the kitchen unit for JandA and Manfood, our food brands. There's been a wireless link across the car park between the two warehouses and the kitchen unit.

The data needs are remarkably low, and a simple 80/20 ADSL (now called SOGEA) line would suffice into both.

I was tempted to put a new wireless link across the yard. The old one isn't ours and hasn't been particularly reliable. I was quite taken by the look of the new Ubiquiti Building Bridge (**tinyurl.com/371bridge**), a two-unit kit of identical circular dishes that are designed to be mounted well above head height on scaffolding poles.

There are two radio connections between the units: one at 60GHz, which is the primary connection, offering up to 1.7Gbits/sec using a 2,150MHz channel width. The fallback connection is at 5GHz and offers 866Mbits/sec on a more prosaic 80MHz channel width. A fallback is necessary because 60GHz tends to dislike obstructions, including heavy rain. The lower frequency radio connection is far less prone to disturbance.

Setting up the units is incredibly simple if you have the UniFi network platform. They are auto discovered and pair to each other with no other configuration required. Within the UI platform, the bridge appears as a single item, which is interesting. Alignment is obviously very important, and there's a cute LED ring around the outside of each unit that changes, in segments, from red to green to indicate proper alignment, and which way to adjust to get the most accurate beam.



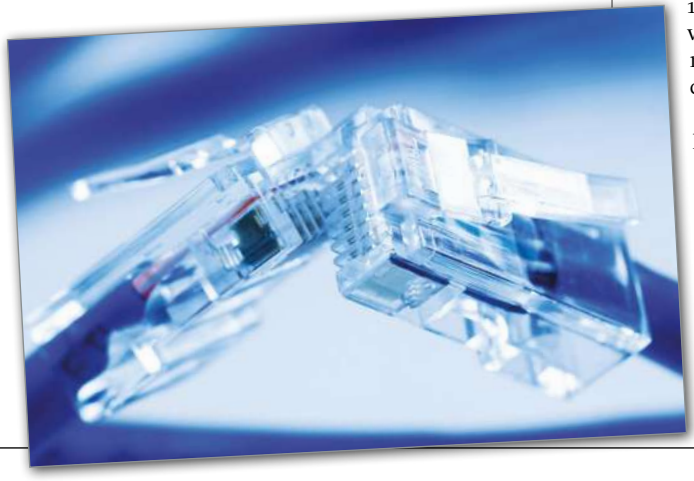

Overall, this is a very nice solution. What has it been like in practice, having been put into position? I can't tell you, because I decided to change plans. Both sites are now getting their own ADSL/SOGEA connection, and both will have their own UI firewall router. This allows for the one-click "Site Magic SD-WAN" facility, which interconnects the LANs of multiple different sites. It's incredibly simple to set up and maintain, so I decided to use this instead.

What will happen to the Building Bridge? Well, I have fibre running across the garden to a double garage at the bottom of the garden. This is an underground fibre connection, but it would be tempting to put the Building Bridge across the same physical link as backup. Or maybe I can persuade the pub next door to let me bridge to them, and install my own Wi-Fi access point for my own private networking while I'm enjoying a pint? Now that sounds like a plan, and would be an entirely sensible test platform.

**ABOVE The UniFi Building Bridge is very easy to set up**

**"Maybe I can persuade the pub next door to let me bridge to them"**

**BELOW My Ethernet connection had become unreliable**



## Dodgy Ethernet cables

I had to call our tame electrician in to do some network cabling. I use our home as a Wi-Fi test environment, because I can control all of the Wi-Fi and ensure that any neighbours are down below -80dBM signal level, and hence down into the noise.

Part of this test rig is having the house flood-wired with Ethernet, so I can position Wi-Fi items in various places. On the far back-side wall of the house I have four Ethernet cables coming down from the roof space switch. There are two upstairs bedrooms on that wall and two downstairs rooms, so one cable goes into each of the rooms. The cabling comes down the brick wall itself in conduits, so it's protected and tidy.

Two of the cables had started to become unreliable. One then simply cut out, the other would only work at 100Mbits/sec, and often threw warnings of disconnection and reconnection. It was time to change the wires.

It didn't take our electrician long to pull the cables carefully through the conduits and then into the rooms. Once this was done, the proper 1GbE connectivity returned and reliability has gone back to 100%.

However, I only became aware of the problems because of the live device monitoring on my network.

You might have a cable run across a warehouse, or through an office space, and it might be getting progressively more intermittent. The client devices might connect through adequately, and no-one really notices apart from a few web browser refreshes being required if the wiring actually dropped for a few seconds. That's why live monitoring is important, so you know exactly what's going on. And this is a big differentiator between unmanaged and managed switches, and especially those managed switches that have a fabric mesh controller which is monitoring all the interconnects.

## Wi-Fi 7 sets new record

I've just set a new speed record on Wi-Fi. I have been playing around with high end Wi-Fi 7 units, especially those from Ubiquiti, my current preferred supplier of networking equipment (as you may have spotted). Its E7 Wi-Fi access point is something of a monster: the specifications should set the tone, starting with a maximum concurrent client count of over 1,000 devices. There's a 10GbE PoE++ feed for primary connection with a backup 1GbE port for luck.

It offers 4x4 MIMO on both 5GHz and 6GHz, and 2x2 on 2.4GHz. The maximum claimed data rate is 11.5Gbits/sec with 320MHz bandwidth on 6GHz, 8.6Gbits/sec at 240MHz on 5GHz and 688Mbits/sec on 2.4GHz at 40MHz bandwidth.

So I set up a 6GHz SSID at 320MHz bandwidth and connected it to my 10GbE test framework to a high-power server running OpenSpeedTest. And I could get 2.85Gbits/sec user data speed connecting from a Samsung Galaxy S24 Ultra phone.

Clearly, Wi-Fi 7 as a platform is starting to stabilise and get the speed capabilities that it has promised from the start, but simply never delivered. I couldn't get faster speed out of MLO (multi link operation) by tying the 5GHz and 6GHz channels together. That might be an issue at the E7 end or the S24 Ultra, but it's almost impossible to know which might be the bottleneck. It should be able to near double the 2.85Gbits/sec speed in this mode. Investigations continue.

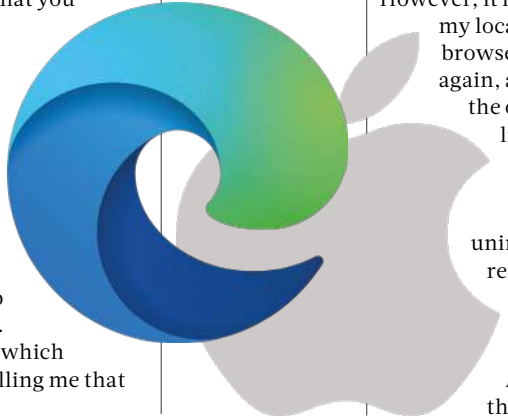
**ABOVE Wi-Fi 7 finally appears to be capable of providing the speeds it promised**

## Microsoft Edge access rights for local network

This was a fascinating problem that took me down quite a deep rabbit hole. As we all know, there will often be local web servers that allow you to interface into services that you have within your local network. Good examples, in my case, are the local admin interfaces into my collection of Synology NAS boxes. As you would expect, this was working just fine from my various Mac desktop and laptop devices on all browsers. Except Microsoft Edge, which for some reason kept telling me that it couldn't find the site.

**"This was a fascinating problem that took me down quite a deep rabbit hole"**

**BELOW Microsoft Edge led me down a deep rabbit hole**



This was curious, and clearly a permissions or configuration issue. So I dived into the Edge settings and really couldn't find anything. A web search suggested that the culprit was in Settings/Privacy search and services, and then down to the Microsoft Edge Secure Network settings. And then to try changing those settings. But this didn't apply to me because it's basically a built-in VPN capability, and I don't use that.

The next obvious place to look was outside of Edge itself, but in the security settings of the operating system. MacOS has a very well defined set of highly granular security settings that get applied to apps. For example, Full Disk Access is required if you want an app to be able to read any file. Or lock down the microphone and camera access on individual apps. By default, apps don't have access to these features, and you have to specifically authorise it, as part of the wider security management.

Another setting is Local Network, which "allows the applications below to find and communicate with devices on your local network". Those with longer memories may even recall that I switched this on when I had problems connecting to local servers (*see issue 366, p112*). Maybe it had been switched off somehow? I scrolled down and found that Edge had this facility turned on but it still wouldn't connect.

Clearly something was amiss. This thought was amplified by the sight of not one, but 21 entries for Microsoft Edge on the list. If you right-click on one entry and choose "Show in Finder" it will take you to the application itself in the apps folder. All entries pointed to the same executable file.

I tried turning off Local Network access for one of the Microsoft Edge entries, and to my surprise, all of the other entries turned off in sync. However, it made no difference to my local IP address in Edge browser. I turned it back on again, and marvelled how all the others turned on as well, like a well-trained army cadet corps. It still made no difference.

Maybe I needed to uninstall Edge, then reinstall it? Would that remove all the entries? I tried that, but it made no difference.

And it wasn't just Edge that was at fault: Google

Chrome has five entries as well, and they work just the same.

Clearly there was something awry in the OS security settings. I searched again and found it might be possible to reset the Privacy and Security settings by deleting some deep-down preferences files, but it was listed as being highly discouraged. The only solution appeared to be to create a new login account on the machine, which would create a new set of settings preferences files. Which is fine, but it didn't fix the problem and meant I would be logging into a fresh workspace.

Now, I admit that the base account on this Intel Mac mini is now some six years old, but it's the first time I've come across a settings or configuration issue that couldn't be fixed easily.

The simple reality appears to be that there's no way of manually deleting items out of the Local Network settings in Privacy and Security, nor any means of doing a "settings chkdsk" (for those of a certain age) to validate that all is correct. Surely the OS should be able to notice multiple parallel and identical entries, then to take appropriate action?

Windows has, for decades, had a reputation of suffering from "Windows rot", where things started going out of tune in ways that could be hard to fix. Often this was entirely unjustified criticism of the operating system itself, and most often could be pinned down to bad third-party drivers – especially antivirus applications that were doing deeply unpleasant things to the base operating system. I hope that this reputation for "OS rot" isn't going to come into the macOS world, too.

Yes, I know that you're thinking: it's high time that I flattened this machine and rebuilt it. But if it works, then why bother? Anyway, it was at this point the computer became sentient and noticed my annoyance. Edge can now see local devices on my LAN and connect to them. I made no change to the settings, but it just works. I still have a large stack of "Microsoft Edge" settings in my Local Network configuration pane, but if it works, I will leave it be for the moment.

jon@jonhoneyball.com

LEE GRANT

# "If you're ever up against a sales rep pushing the eco-message, ask them about spare parts"

**One customer is asked to perform unspeakable horrors on an innocent mouse, while another desires much noisier buttons**

It's heartening to know that I can still be surprised. Earlier in the year, I received a reader's email with the subject "Incredulous" and, after reading what they had to say, you may agree.

Alan was the happy owner of an Aerox 3 mouse made by SteelSeries. It isn't a brand I encounter too often, but its vast range of peripherals is a hit with the gaming fraternity. Alan's Aerox 3 had fulfilled its murine mission for some months before spluttering its final squeak.

Alan contacted SteelSeries' support, who popped into life full of apologies and assurances of in-warranty returns. Earning extra points for environmental integrity, Alan enquired if there was a repair option, but SteelSeries explained: "We do not have an official repair service for these sorts of cases as of yet." This is disappointing, but most peripheral manufacturers have been able to ignore repair for decades. As most no-frills mice cost less than £15, they fall into the "yeah, but no" category of devices where spare parts should be available, but new products cost so little that most users will just replace.

SteelSeries had better news for Alan and was ready to issue a replacement mouse once he'd completed its RMA process (**tinyurl.com/371steel**). I'm sure most *PC Pro* readers have jumped through various hoops to get replacement products. I have, but SteelSeries wanted *Gladiator*-levels of hoop work.

Alan was asked to submit the serial number of the mouse before being given abnormally specific information about images. "Speaking of photos, we'd love a view of your entire product from every angle. Snap a shot of the front, back, and both sides, ensuring that you also capture that serial number. The more, the merrier, right?"

**Lee Grant and his wife have run a repair shop in West Yorkshire for over 20 years**
**@tnargeel.com**

**BELOW SteelSeries is actively encouraging customers to destroy their own products**

Glossing over the patronising tone of the customer service script, Alan submitted the information and an album of images. Two days later, an email arrived from SteelSeries saying: "Your warranty claim is pending the successful completion of our verification process." This was excellent news, as Alan moved one step nearer to getting a replacement mouse, but how was SteelSeries going to verify it? Usually OEMs ask for users to return products back to base for a test, but SteelSeries' email requested an unexpected and unorthodox method: "We will ask you to provide proof of destruction in order to proceed with your claim."

What followed were several instructive paragraphs on how to break mouse buttons and how to take more photographs of this wanton act of vandalism. The section entitled "What do I do with my Destroyed Product?" is intriguing. From a linguistic perspective, the language used now transfers ownership of the problem, as well as the wrecked remains of the SteelSeries mouse, to Alan, but he's assisted by a link for him to find certified e-recycling facilities. This link opens up a Google Maps search for "e-waste recycling near me" which, in my case, highlights trade-only providers that Alan can't access.

Alan informed SteelSeries he would not wilfully destroy the mouse, but was happy to return it to them. He also said, "sorry, but I have spent too much time caring for my equipment to be able to now destroy something deliberately". Let's take a moment to raise a glass to Alan. Cheers!

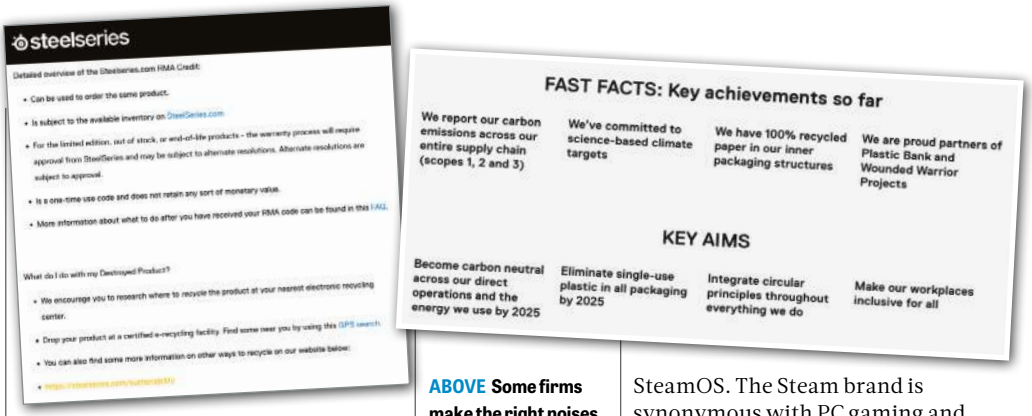
SteelSeries responded: "Unfortunately, we do not take ship-ins anymore, as our RMA process has gone fully remote." Personally, I think that should read, "Our remote RMA process has fully gone", as SteelSeries has no recognisable returns process and by asking Alan to smash his mouse and take it to a local recycling centre, it has also unloaded its material-processing costs onto municipal taxpayers.

Of course, that's not what its corporate sustainability (**steelseries.com/sustainability**) statement implies when it speaks of making "the right choices by people and planet". Its recycling statement (**steelseries.com/sustainability/recycling**) starts off well – "All SteelSeries products have parts that can be recycled and repurposed" – but then performs a responsibility-reversal with: "You can help by taking your electronics, not just SteelSeries products, to local retailers and drop-off points to ensure they are processed properly."

My issue is that these statements are at odds with each other. If SteelSeries is truly making products that can be "recycled and repurposed" then neither process will happen (at scale) unless products are returned to the company. Returning products to local retailers (hello!) and drop-off points will result in the probable scenario that SteelSeries products will end up in a crusher where the only thing being recycled is meaningless corporate promises.

By making "recycled and repurposed" products and not having a closed-loop recycling system to enable metals reclamation or self-seeding PCR plastic stocks, SteelSeries seemed to be paying lip-service to sustainability. Its website states that it integrates "circular principles throughout everything we do", so it was time to get a definitive response. It started well, with the PR team saying they were keen to "collab more!".

I asked SteelSeries to explain how Alan's experience fits with a circular strategy, why SteelSeries, especially for a product under warranty, makes recycling the customer's problem, and why it also doesn't have any form of mail back/collection in the UK. While I was at it, I enquired if it intended to introduce closed-loop recycling systems or, like Logitech (**ifixit.com/collaborations/logitech-uk**), develop user-repairable products. Sadly, I didn't get any response. Nothing. Not a word. Suppose I won't be able collab more after all.


steelseries
FAST FACTS: Key achievements so far
We report our carbon emissions across our entire supply chain (scopes 1, 2 and 3)
We've committed to science-based climate targets
We have 100% recycled paper in our inner packaging structures
We are proud partners of Plastic Bank and Wounded Warrior Projects
KEY AIMS
Become carbon neutral across our direct operations and the energy we use by 2025
Eliminate single-use plastic in all packaging by 2025
Integrate circular principles throughout everything we do
Make our workplaces inclusive for all

**ABOVE Some firms make the right noises about sustainability but don't back it up**

## Swabbing the Deck

Many tech firms are using their environmental credentials to woo us into spending money on their products. If you're ever up against a sales rep pushing the eco-message, ask them about the availability and fair pricing of spare parts. You may not get an answer to your question, but they'll probably leave you alone to peruse in peace. Through this column, I have the privilege of being able to talk about the Right to Repair movement and the implications for us all, but there's another facet of fixing that I rarely discuss. Instead of waffle, let me give you an example.

Several months ago, Thomas arrived in the shop with bags of replacement gaming parts. This moment resulted from weeks of back and forth to discuss upgrades to his Steam Deck. If these devices have passed you by, they're handheld, portable gaming machines that use a custom Linux operating system called SteamOS. The Steam brand is synonymous with PC gaming and these devices extend the super-simple platform into dedicated hardware.

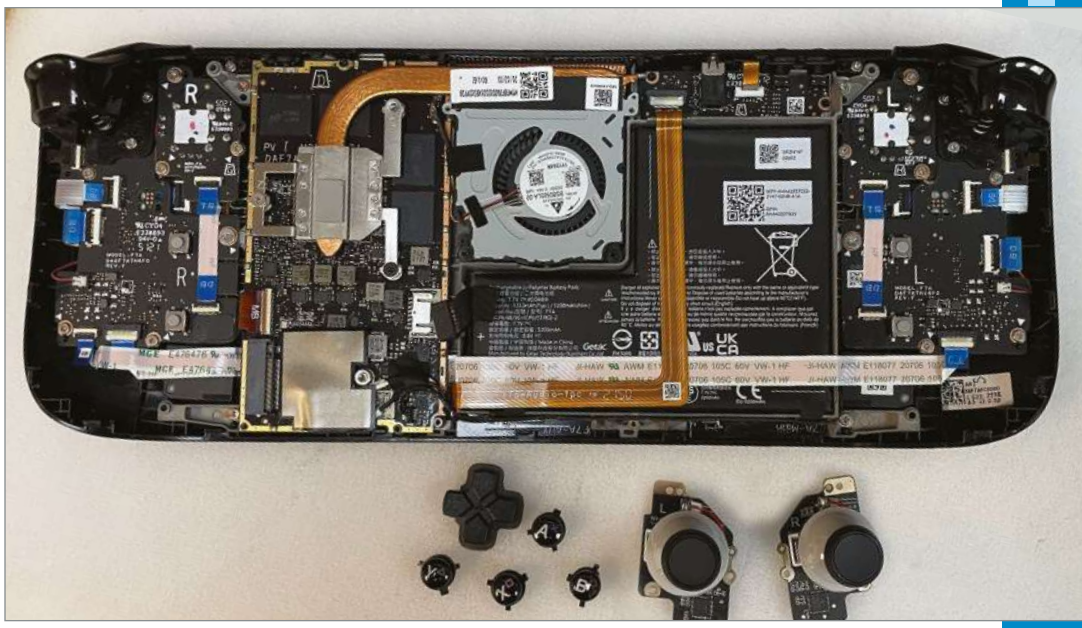
**"To me, Steam's brilliant execution is secondary to its repairability"**

Various Steam Deck owners have eulogised about the playability of these machines but, to me, Steam's brilliant execution is secondary to its repairability. Simply, Valve built the Steam Deck for repair and doubled down on this with an iFixit collaboration to supply spare parts and repair documentation. This has opened up a market in original and quality third-party parts, a selection of which Thomas had plonked onto my counter.

What makes Thomas' story unusual is that his Steam Deck wasn't broken. He wanted me to customise it in five different ways. I had to swap the D-Pad, ABXY buttons and joysticks. Also, the microswitches beneath some buttons were to be swapped and the SSD upgraded to 2TB. As you'll see, all of this is possible because the Steam Deck is repairable.

Conversely, if Thomas had brought me a bog-standard laptop for equivalent changes, I would have probably refused. Customising a working device that isn't built for tinkering is a high-risk strategy and one that makes my accountant grumpy if it goes wrong.

**BELOW The Steam Deck is great for gamers and even better for repairers**



The most complicated replacement was the microswitches. Thomas had sourced a Clicky Kit created by ExtremeRate (**youtube.com/@ExtremeRate**) to replace the standard buttons with noisier versions (I didn't ask), and the package that arrived was very impressive. It contained tools, screws and the two flexi-PCBs requiring a liberal application of hot air to get into place. The accompanying step-by-step YouTube tutorial is very thorough, making installation extremely simple.

The replacement D-Pad and ABXY buttons were impressive 3D-printed items Thomas had found on Etsy, and the replacement joysticks were made by another third-party supplier called GuliKit (**tinyurl.com/371GuliKit**). The joysticks use a version of a Hall Effect sensor to remove problems such as drifting, creeping and blind spots; it's the same technology that Nintendo has introduced to the Switch 2.

Upgrading the SSD was a little more usual. Steam Decks use a non-proprietary M.2 2230 slot, and the cloning process was identical to most of the others I've done. If you're thinking of trying this one yourself, then opt for Clonezilla (**clonezilla.org**) as Windows (in various guises) kept locking partitions out of the cloning process, resulting in fails. Before I move on from cloning, I'm writing this month's column on one of the new (but refurbished) M4 Mac minis, and these have upgradable SSDs. Shortly I shall upgrade the 256GB to 2TB without the need to pay Apple a fortune for the privilege. I'll let you know what happens later in the year.

Thomas' Steam Deck spent a few hours under the knife and, after a few days of putting the machine through its paces (loud clicks and all), he was really pleased with the result. A repairable machine, like a Steam Deck, gives the user parts to fix or tweak beyond what Valve envisaged. Framework has a similar ethos for its laptops and supports a community that creates and shares innovative ways to utilise the hardware. It's refreshing for us all to be reminded that the ability to access basic parts to keep our devices going shouldn't be difficult. Speaking of which...

## If you rolled a two or more, turn the page

You'd think that with all the progress that the Right to Repair movement has made that sourcing basic items such as laptop batteries would be much easier. In recent months, I've flagged various OEMs who seem to be moving in the right direction and have greatly improved their spares offerings. The problem for us as tech owners is that the parts supply isn't uniform across a range. It's often feast or famine, and the unpredictability of precisely which parts are available affects my business. When a customer asked me to source for a replacement battery for their Asus laptop, I was uncertain that I'd be successful. Although the laptop was a 2021 model, none of my usual suppliers had anything that would fit, either in original or third-party flavours.

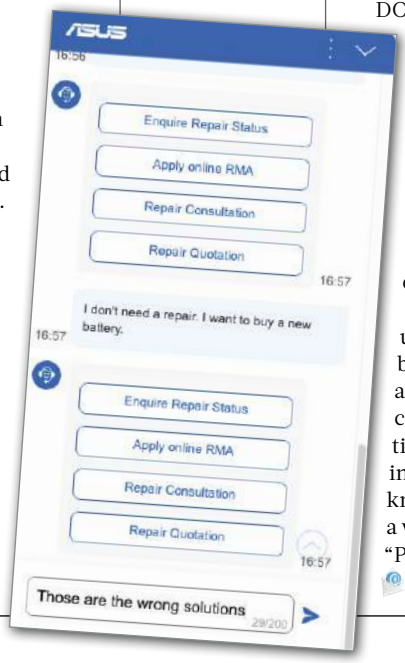
Over the years, various OEM representatives have explained that this scarcity is because of an unplanned fault in the product line and, instead of going to all the expense of a recall, it's more profitable to keep schtum, hope no-one notices and fob off the ones that do. Let me make it perfectly clear that these explanations are 100% unofficial and anecdotal, but what is true is that I've been told basically the same thing by different vendors for years, and it makes a lot of sense.

While I waited for other suppliers to rummage down the sides of their sofas, I rolled the dice and contacted Asus via its virtual assistant. Sadly, this isn't a shiny AI-fuelled concierge that will "understand" my request to buy a battery, but an ancient labyrinth of "choose your own adventure" options with uncertainty behind every click. Many times did the Asus dragons thwart my battery quest and I was thrown back to the start to heal my wounds and begin again. One attempt forced the Asus Assistant to display the message, "We apologise. Our chat service is currently closed." When did VMs get tea breaks?

**ABOVE The updated Steam Deck was fitted out with noisier buttons**

**"The problem for us as tech owners is that the parts supply isn't uniform across a range"**

**BELOW Asus' virtual assistant is like a "choose your own adventure" game**




Eventually, I confused it enough that it forwarded me to a humanAId (an online entity that is perceived as a real person but could be AI wearing a convincing hat). Asus informed me that it doesn't sell spares separately from devices and gave me a link to the same third-party sellers who also didn't have the parts.

This customer ditched the Asus and bought something else, purely because they couldn't source a compatible battery for a four-year-old laptop. We're still two years away from EU regulation on laptop batteries, and I hope it eradicates nonsense like this.

## The spring that sprung

In other power news, a Dell came in for what darts players would call a "Shanghai". The battery, charger and DC socket all needed replacing, a process Dell has made very easy (take note, Asus). What made this repair less easy was the retention spring holding the low-profile Ethernet hatch making a break for freedom as I removed the bottom cover. A move that the cheering throng at the Ally Pally would call "Missing the Island".

It was close to 40 minutes under the microscope to get it back together and serves as another reminder that things can go wrong. Such as the last time I played darts and ended up in hospital for five days. I don't know if the darts community has a word for what happened to me. "Pincushion", perhaps?

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OLIVIA WHITCROFT

# "We're often asked to sign up to crazy liability terms in the tech world"

**An invitation to a child's birthday party makes Olivia consider being a party-pooper over the liability terms she has to sign**

My daughter is excited to go to a birthday party this month, being held at an activity centre. All parents have been sent a link to a waiver that we need to sign for our children to participate. Parents are responding one by one: "Signed it." I am just opening it up.

First line: "I accept that there is... danger and risk of physical or emotional injury, paralysis, death, or damage to participants."

Just what every mother wants to hear.

Next paragraph: "Activities are undertaken at the participant's own risk and I will not hold the venue liable for any injury the participant may suffer."

Tough luck for us if any of their equipment is faulty.

There's more: "I will indemnify the venue against any claim... for loss, damage, injury or death which has been caused by any action or omission of any participant."

To summarise: it's all on us if something goes wrong.

I can't think of anything I want to sign less. But am I going to be the parent who doesn't let their child attend a friend's party because she refuses to sign the waiver? Or the lawyer who delays anyone being able to take part while I'm demanding to speak to the person who drafted it to discuss amendments?

As with other similar venues, we are presented with something that is scary to read, lengthy and hard to understand, and unlikely to be fully read by many. And yet everyone signs them in a hurry so that the fun can commence.

Couldn't these things be a bit more parent-friendly? Personal injury is not one of my legal specialisms, but how about:

**Olivia is principal of the law firm OBEP, which specialises in technology contracts, IP and data protection**
**@ObepOlivia**

**"Am I going to be the parent who doesn't let their child attend a party because she refuses to sign the waiver?"**

- The venue will ensure the facilities are safe and age-appropriate.
- We will check our child is fit enough to take part and doesn't act like an idiot.

## Crazy tech terms

We're often asked to sign up to crazy liability terms in the tech world, too. Here are some I've seen recently.

**a) Services agreement:** "The Customer will not make any claim against the Supplier... unless the loss or damage arises from gross negligence or wilful misconduct." So it's tough luck if the supplier is only slightly negligent and causes my system to explode?

**b) Software collaboration agreement:** "The Information is provided... without any warranty... as to its accuracy or completeness, use or fitness for a particular purpose." It's not a great foundation for the relationship if the supplier provides fictitious information about its software.

**c) Agreement for data processing services:** "In no event shall the Provider be liable for... loss of or damage to data..." That gives me a lot of confidence in uploading all my confidential data to your systems.

Couldn't these things be a bit more customer-friendly?

A customer may not be willing to appoint a supplier who doesn't accept any responsibility when things go wrong. Yet some of these provisions do make it through to signature. In some cases, the customer has undertaken a proper assessment and acceptance of the risk. But in others the terms aren't read or understood, or they're presented as standard and non-negotiable.

## Enforceability

I've been giving the impression that if the terms are crazy, you would be crazy to sign up to them. But the law does give some protection against liability limitations that go too far, even if you do agree to them.

It isn't possible to exclude or restrict some types of liability (in a contract or notice). This includes (for most contracts) liability for death or personal injury caused by negligence, and exclusion of certain implied warranties in B2C contracts (for example, relating to the quality of goods, or skill in performing services).

Terms seeking to exclude or limit other types of liability (in B2C or B2B contracts) may also be subject to a "fairness" or "reasonableness" test to determine whether they are effective. Various factors can impact this, such as what losses may be anticipated, the bargaining power of the parties, the availability of insurance, any inducement to agree, and whether the restriction is usual and understood. It's a complex topic that is much discussed by the courts, making liability provisions some of the trickiest to draft and advise on.

Leading on from this, if you're presented with a contract including a term that you think is unfair, should you sign it anyway, knowing that if there were a dispute, you can argue that it's ineffective? If you're in a weak bargaining position, and under pressure to sign, this may help. It was going through my head when I was presented with the waiver. But if you can negotiate, non-existence of the term may be preferable to arguing its unenforceability.

As the supplier, sneaking through unreasonable liability limitations could act as a deterrent to your customer bringing legal action. But if they are ever tested, they may fall down.

**BELOW A waiver for a birthday party at an activity centre wasn't very parent-friendly**

ABOVE **The law gives protection against liability limitations that go too far**

And if limitations on your liability go away, that means your liability is unlimited, which could be a lot worse than if the terms had been fairer.

## Back to the crazy terms

Are the terms I shared above likely to be binding?

Term (a) is unlikely to be fair in a B2C contract, and wouldn't be effective in excluding liability for breach of statutory warranties. It also gives me concern in a B2B scenario, unless the supplier can demonstrate it was negotiated (or negotiable) and the risk was accepted (perhaps as a trade-off for price or other matters).

Under term (b), the supplier doesn't promise that data it shares is accurate or suitable for the collaboration (B2B). We need the wider context to assess whether its effect could restrict liability for what is expected. In itself, it isn't obviously unenforceable, but if the other party is relying on good-quality information, it may not want to enter into the relationship.

Excluding liability for loss of data in term (c) may be a problem, though it depends on the meaning of "loss". If the intended service isn't for data storage or backup, it could be reasonable to expect the customer to maintain its own copies and not rely on the provider retaining records. But it may be less reasonable to exclude liability for a data breach that leaks confidential or personal information. I think clearer drafting is needed.

## Liability caps

Another way to limit liability is to set a maximum amount that a party would pay in the event of a breach. But if the cap is too low, it risks unenforceability, as discussed above.

Insurance cover can impact the choice of cap. I was advising a client undertaking software development on a liability cap for its standard terms. It looked at its insurance policy, which had a limit of £1 million for claims under it. So it proposed to put a cap of £500,000 per claim in its terms. This would ensure that any claim was covered by its insurance policy, right?

We dug a bit deeper and discovered a few problems. First, the limit in their insurance policy was £1 million "in the aggregate"; in other words, for all claims. If my client had 20 customers, who each made a claim for £500k, my client could be liable to pay £10 million. And its policy would only cover £1 million of that.

Second, the insurance limit was £1 million for the year covered by the policy. But my client was suggesting a £500k cap per claim under its terms. If each of the 20 customers made, say, three claims of £500k in the year, my client could then be liable to pay £30 million. And its policy would only cover £1m of that.

Third, not all potential claims were covered by the policy. It's common for professional indemnity policies to exclude certain types of loss, such as cyber incidents and personal injury (as they can then sell you separate cyber liability and public liability insurance policies). In my client's case, it was even worse than that: its policy covered services provided by another arm of its business, and did not obviously cover claims relating to software development.

So its policy would, in fact, not cover any of the £30 million claimed by its customers. Needless to say, I advised my client to re-think both the cap and the insurance cover.

Another common approach is to relate a cap to fees paid, such as (with a made-up example) 250% of fees paid in a year per claim. Often, I see terms capping total liability at the same amount as fees paid. On the face of it, it sounds fair – you paid me £200 for my services, so I'm not going to pay more than £200 back to you if something goes wrong.

But is that actually reasonable? Let's draw a parallel with my personal injury example. If I pay £20 for a ticket at the activity centre, and then suffer an injury due to faulty equipment, is it fair to limit my compensation to the £20 I paid? (Before you say it: a term restricting liability for injury arising from negligence is also ineffective.)

In some cases it *could* be fair to set a cap at fees paid; if I don't provide what you've paid for, I'll give you your money back. But the consequences of non-performance need to be thought through to determine this.

**"An indemnity can be a powerful remedy under a contract"**

## Watch out for indemnities

An indemnity can be a powerful remedy under a contract, requiring one party to compensate the other for costs arising from particular issues (such as intellectual property infringements or breaches of specific terms). But it's not always clear whether liability limitations and caps placed elsewhere in the contract apply to such indemnities.

As a customer, you may be delighted to read that the supplier will indemnify you should its software infringe someone else's rights. But you may be less happy to discover that such indemnity is subject to the £100 liability cap that it snuck in. On the other hand, the supplier may find the indemnity falls outside the cap and other provisions limiting liability.

So how about just being blunt about it: "The liability limitations under clause 5 [do][do not] apply to the indemnity under this clause 7."

## Bad and good provisions

Random, tricksy, irrational or confusing provisions limiting liability do not cast a good impression and may face problems should anyone need to rely on them.

My tips for drafting a good liability provision: think through what issues may arise, and what losses either party may suffer. Determine (or negotiate) how much risk and liability it is fair for each party to take on. Then draft and present the provision clearly so that both parties know what they are agreeing to.

Postscript: in case you were wondering, my daughter survived the party unscathed.

olivia.whitcroft@obep.uk

BELOW **Good liability provisions should be negotiated in advance**

DAVEY WINDER

# "Everything I have heard points towards these attacks starting with an old chestnut"

**In light of the ransomware attacks on M&S, the Co-op and Harrods, Davey analyses how it happened and what you can do to stop it happening to you**

When it comes to icons of the British high street, they don't come much bigger than Marks & Spencer. Even if you aren't a lady of a certain age keen on getting a new girdle at the same time as buying some expensive tomatoes, the fact that M&S has been hit by ransomware attackers should worry you. Especially when another huge name in retail, the Co-op, fell to the same attackers soon after. It remains unclear if the same group was responsible for both, although it does appear to have made that claim.

The final member of this very British retail trio, Harrods, has said that it was also targeted, but a spokesperson confirmed it "immediately took proactive steps to keep systems safe" by restricting internet access to impacted sites.

I'm taking the unusual step of devoting my entire column this month to these attacks. In particular, investigating the group behind them and the methods employed, and sharing mitigation advice that stretches beyond the retail sector to help prevent all organisations becoming another ransomware victim.

## The attacks...

We will, no doubt, have to wait many months for the results of the ongoing official investigations by the stores and law enforcement to become public. Even then, I can't predict the level of technical disclosure. That doesn't stop me from conducting some investigative digging of my own, with the help of industry colleagues, and getting a reasonably good idea of what happened in terms of attack methodology.

**Davey is a journalist and consultant specialising in privacy and security issues**
𝕏 @happygeek

**"It seems they opted for the method of impersonating staff and calling the IT helpdesk"**

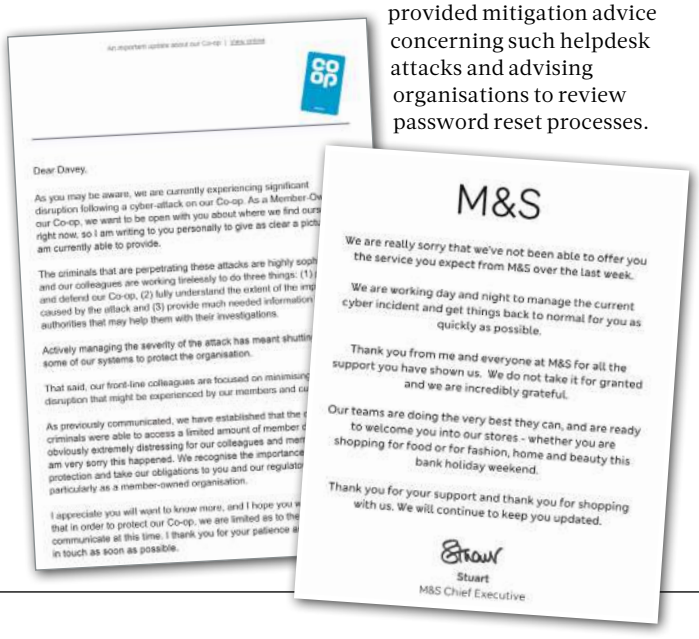
**BELOW Both the Co-op and M&S were badly hit by the recent ransomware attacks**

So let's start there, shall we? Everything I have heard has pointed towards these ransomware attacks starting with an old chestnut. One that has become the vinegar-soaked, oven-baked, resin-coated conker of initial access tactics: the IT helpdesk impersonation scam.

First, I want to take a quick detour and talk ClickFix attacks. These use social engineering to get the victim to a website supposedly protected by Cloudflare, where a CAPTCHA is presented for authentication. This CAPTCHA is fake as well, and dangerous. It ultimately uses a malicious PowerShell command copied to the clipboard to launch a download and yada, yada, yada.

The M&S attackers, however, didn't bother with such shenanigans. Instead, it seems they opted for the more straightforward method of impersonating staff and calling the IT helpdesk. I have spoken to numerous cybersecurity insiders and all have agreed that this is the attack methodology they have heard was responsible.

More evidence? Soon after the trio of retail ransomware attacks, the National Cyber Security Centre (NCSC) issued an advisory that provided mitigation advice concerning such helpdesk attacks and advising organisations to review password reset processes.


Dear Davey,

As you may be aware, we are currently experiencing significant disruption following a cyber-attack on our Co-op. As a Member-Ow... our Co-op, we want to be open with you about where we find ours... right now, so I am writing to you personally to give as clear a pictu... am currently able to provide.

The criminals that are perpetrating these attacks are highly soph... and our colleagues are working tirelessly to do three things: (1)... and defend our Co-op, (2) fully understand the extent of the imp... caused by the attack and (3) provide much needed information... authorities that may help them with their investigations.

Actively managing the severity of the attack has meant shuttin... some of our systems to protect the organisation.

That said, our front-line colleagues are focused on minimising... disruption that might be experienced by our members and cu...

As previously communicated, we have established that the c... criminals were able to access a limited amount of member d... obviously extremely distressing for our colleagues and mem... am very sorry this happened. We recognise the importance... protection and take our obligations to you and our regulato... particularly as a member-owned organisation.

I appreciate you will want to know more, and I hope you w... that in order to protect our Co-op, we are limited as to the... communicate at this time. I thank you for your patience a... in touch as soon as possible.

M&S

We are really sorry that we've not been able to offer you the service you expect from M&S over the last week.

We are working day and night to manage the current cyber incident and get things back to normal for you as quickly as possible.

Thank you from me and everyone at M&S for all the support you have shown us. We do not take it for granted and we are incredibly grateful.

Our teams are doing the very best they can, and are ready to welcome you into our stores - whether you are shopping for food or for fashion, home and beauty this bank holiday weekend.

Thank you for your support and thank you for shopping with us. We will continue to keep you updated.

Stuart
M&S Chief Executive

The NCSC specifically singled out paying attention to "Domain Admin, Enterprise Admin, Cloud Admin accounts, and check if access is legitimate," as well as reviewing how the "helpdesk authenticates staff members credentials before resetting passwords, especially those with escalated privileges".

The helpdesk attack risk can be amplified if, as is more often the case than not with larger organisations, it's outsourced offshore. One respected security veteran summed it up as teenagers phoning helpdesks and pretending to be the CISO, with the outsourced staff not knowing the organisation staff that well and flagging such calls as being from a VIP.

## The attackers...

There remains some confusion over who was responsible for the attacks on all three retail giants, but that isn't unusual. Criminal groups and affiliates like to muddy the waters to throw law enforcement off the scent while, at the same time, garnering media attention and kudos from peers.

At the time of writing, I am as near certain as is possible that the DragonForce ransomware-as-a-platform service was employed. While Scattered Spider is thought to be involved, as an indeterminate collection of cybercriminals rather than a specific group, it's probably more useful to focus on DragonForce.

DragonForce is one of many such ransomware-as-a-platform operators, whereby affiliate cybercriminals can use the ransomware malware developed, updated and controlled by the DragonForce masterminds to attack targets. These affiliates not only have access to this ready-made malware but also utilise a control panel that includes purpose-built negotiation sites for post-attack ransom demands.

I am led to believe that for doing all the donkey work, including taking the most risk of getting caught, of course, the affiliates can take up to 80% of any successful ransom payments, the remainder going to the DragonForce platform operators. Which doesn't mean you should ignore the Scattered Spider threat – far from it, and I'll return to that momentarily.

According to my threat-intelligence buddies at Group-IB, DragonForce was first observed in August 2023, so they've come a long way in a relatively short amount of time. The affiliate program itself wasn't launched until 26 June 2024, which just goes to show the power of farming out ransomware

malware in this fashion. "Affiliates can create customised ransomware samples," Group-IB says, "including disabling security features, setting encryption parameters, and personalising ransom notes."

DragonForce is, to the best of my understanding, purely motivated by money. It isn't a geopolitical force. It has extended this business-like approach to crime to its branding, making its platform available to other groups providing ransomware-as-a-service operations. This saves the other groups money as they don't need to keep their infrastructure up to date, and provides DragonForce with more exposure and kudos – plus another ongoing revenue stream. This "white-label" approach to ransomware attacks, alongside the diverse attack affiliates involved, just makes attribution and, critically, law enforcement action even harder.

Turning briefly to Scattered Spider, this loose collection of threat actors, some of whom are known to be English-speaking teenagers, hang out on specific Telegram channels and Discord servers where attacks are planned. Scattered Spider is, are, whatever, also known to provide affiliates to DragonForce, hence the confusing attribution in the M&S and Co-op cases.

Interestingly, Scattered Spider ransomware attacks are often associated with IT helpdesk social engineering campaigns for initial access. The helpdesk scam is, I would suggest, preceded by phishing campaigns designed to gain employee details or, at the very least, highly specific reconnaissance missions aimed at gathering the same information from social media and surface web sources. This enables them to have genuine employee names, IDs and other information that can be used to convince the helpdesk staff that they're dealing with a legitimate support call.

## The impact...

Where to begin? Any successful ransomware attack, and by that I'm not talking about success through the optics of payments being made or not, will impact the victim in many different ways. There's the most obvious, of course, in that business continuity will be hit, which means that revenue will be hit as well. No matter how good the incident response and business continuity plans are, there are few organisations that can soak up a ransomware attack without taking some damage.

Then there's the impact on customers and business partners whose data may well have been compromised. Most ransomware attacks, including those from the likes of DragonForce, will exfiltrate data to be used as ransom leverage. Whether it's the threat of publishing sensitive customer data to the dark web or offering confidential corporate information for sale to the highest bidder – or a combination of both – data talks. When it comes to ransomware, stolen data shouts from the rooftops.

Not everyone agrees with me. I've seen the argument made that customer data isn't valuable as everyone's data is leaked out there already. Still, this is a big impact issue. That data will be used to propagate further attacks; maybe not by ransomware actors, but by cybercriminals of all types, including the lowest of the low scumbags using it as part of their phishing threats. Anything that can engender trust within a conversation is valuable.

One impact area rarely given the emphasis it deserves is that of reputational damage. Even in these times of ransomware attacks being seemingly so commonplace that nobody is surprised any more, anything that stops a customer from being able to use a service, that has the potential to have their personal data compromised, that screams "we don't take your security seriously enough" is going to be harmful to an organisation's reputation and, ultimately, its bottom line.

After all, there's no such thing as a real online service monopoly these days; customers always have the choice to vote with their wallets and shop elsewhere. I spoke to a media intelligence outfit – yes, they exist – called CARMA (geddit?) after the Co-op ransomware attack and discovered some shocking statistics: 69.3% of media mentions of the Co-op brand carried a negative sentiment following the attack. This was much better than M&S, which sat at 84.6%.

**ABOVE** Harrods took steps to mitigate the severity of the attack

**"Data talks. When it comes to ransomware, stolen data shouts from the rooftops"**

**BELOW** M&S suffered from plenty of negative media coverage after the attack

Neither of those figures are great, but it would appear that the Co-op fared better. This is reflected, far less scientifically, by how often I saw "Co-op spokesperson" in media mentions: this shows that it took a quick and proactive stance in response to the attack.

As the old saying goes, a reputation takes a lifetime to build and minutes to wreck. Making those minutes, hours and days after an attack count is critical unless you want the stain of ransomware to taint your brand for years to come.

## The mitigations...

So to the big questions: what could these retailers have done differently to prevent DragonForce from being successful in the first place? And how can your organisation employ these mitigations to protect both your business and your customers?

I don't usually do the cybersecurity experts round-robin thing in my Real World Computing column on the basis that it's my expertise, my opinions, that you're paying to read. On this occasion, please forgive me for doing so, though, as I think it would be helpful to understand the breadth of advice that has been prompted by the retail ransomware frenzy.

Here goes.

**1.** Don't treat cybersecurity as some kind of compliance tickbox exercise instead of a proactive and ongoing process. "Defending against today's threats requires

Continued from previous page

more than technical controls; it demands building human capability through consistent security awareness and phishing prevention training. Companies that wait until a breach hits the headlines to act are already too late."
*Jay Bavisi, president, EC-Council*

**2.** Don't just authenticate users but also validate their risk postures. "Combining behavioural analytics with centralised access governance ensures that only the right people, not just the 'right credentials', can access critical systems."
*Piyush Pandey, CEO of Pathlock*

**3.** Create a threat model for your entire enterprise, identifying the attack surface area and your exposure to threat actors. "This can apply to applications, the network and, most importantly, customer-facing employees such as the helpdesk. Securing the perimeter of an organisation needs to include a tailored strategy for each entry point."
*Aditi Gupta, senior manager, Professional Services Consulting, Black Duck*

**4.** Don't underestimate the importance of effective threat detection along with a proven, mature, incident response plan to swing into action upon doing so. Immutable backups are beneficial only if they're tested regularly and are part of that comprehensive response plan. "A well-rehearsed incident response strategy helps to identify and remediate any weaknesses in the plan, improve internal communication, and build employees' confidence to respond quickly and effectively to a real incident."
*Richard May, product development director, virtualDCS.*

Okay, enough of the industry voices. I'll finish with a few mitigating pointers of my own: implement a multi-layered defensive strategy, enable multi-factor authentication everywhere, apply the principle of least privilege everywhere, and make sure your IT support, outsourced or not, is aware of the threat and taking adequate defensive action of its own.

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**STEVE CASSIDY**

# "It's not new, the denigration of IT personnel as interchangeable, incompetent drones"

**After a chance meeting with an accusatory MP, Steve is forced to defend the much-maligned reputations of IT staff and journalists**

Even I, with my exotic lifestyle and winning social manners, do not expect to bump into an MP just wandering around the streets of London. It's taken four decades or so for us to be sitting in the right place at the right time – that is, outside a noodle bar at some wobbly metal tables just after 8pm, a bit north of the National Gallery in Chinatown. My partner is the one with the parliamentary employment history, and she jumped up from her outdoors seat in an instant, chasing a nice grey-haired chap inside. One moment later and we were doing the introductions, and that slightly edgy moment when my career crops up in conversation. Quick as a rattlesnake, the politician said: "IT, is it? You blokes are in a lot of trouble right now."

Definitely a moment when I wanted my hottest, snappiest response ready, and definitely the occasion when I came up dry. For a short while I couldn't really figure out what he was referring to; eventually the penny dropped. He was referring to the swathe of large-scale hacking attacks on retail businesses, supermarkets and so on, which took place in May. From where he was sitting, as a member of the House of Commons in his mid-70s, the remedies for the problems that beset the big supermarket brands in those weeks were firmly in the hands of the "IT crowd", and we had been found wanting in our responses at the time. So much so that within a few seconds of being introduced to an IT person, he was permitted to pass judgement, to wonder why I wasn't burning the midnight oil somewhere fighting back the hordes of hackers.

It's not a new thing, the denigration of IT personnel as interchangeable, incompetent drones. In reality, I'd not dare touch either the security systems, or the line of business (LOB) applications that run the checkouts, online orders and warehousing in a live, operational supermarket chain. I'm more at home with a wider range of devices and software products. Several friends tell me that I miss out on the middle ground, concentrating more on the very big stuff and the very small. None of these subtleties was apparent to our new acquaintance the Member of Parliament. He went for the idea of collective guilt right from the start, leaving me pondering the right responses to such accusations for us as IT professionals.

**Steve is a consultant who specialises in networks, cloud, HR and upsetting the corporate apple cart**
@stardotpro

**"He went for the idea of collective guilt right from the start, leaving me pondering"**

There's a low blow option: if anything, the last decade has been an unbroken parade of heroism and public service by IT people and even IT journalists, as part of the incredible saga of the Post Office software project. A story so scandalous it's been made into a TV series, with several of my personal friends portrayed as the heroes of the situation, and plenty of accusations laid at the door of politicians and civil servants along the way. While MPs may feel it's their public duty to call out lazy or hidebound behaviour in professions that need to sharpen up their act, the recent spate of break-ins and ransomware ultimatums in the high street retail business are not going to find their resolution by thousands of uninvolved techies giving their best Hard Stare at the infiltrated system or recently departed, disgruntled employee looking for a few fast bucks.

**BELOW The Post Office scandal was uncovered by heroic IT journalists**

The issue here is actually nothing more than coding oversight. The holes used to gain access to a server are holes in the making of the applications that server is running. Some of those holes are due to buttons clicked during setup or later in the operational lifecycle; others are more subtle omissions and well-known shortcuts, or just old ways of doing things, which are by their very nature hard to spot if you're just a customer trying to stand up their website.

## Building apps in the last century

It may help if you understand how code was turned into applications when life was a lot simpler in information technology. I was lucky when it came to coding. We had a couple of rooms full of VAX minicomputers, though back then "mini" meant "up to the size of a railway locomotive".

My luck was three-fold. My employer was keen to buy and try every programming language under the sun, and accepted nothing but the biggest and best in every generation. I was coding in a very familiar and recognisable BASIC, as found on the ZX Spectrums and Commodore 64s of the time, but my host machine was about as uncommon as they come: we had the third VAX 8600 in the UK, and the first one not deployed with some shadowy military unit. I could also use Pascal, and even COBOL on the big VAX – not a normal situation in the early 1980s, for no other reason than that each language compiler was licensed and the licence price was in the tens of thousands of pounds range.

The process of making a program was common across all the languages on the machine. First you wrote your source code, then ran the compiler against the saved plain text program. The compiler was there to tell you where you'd done something silly, whether that was a typo in a reserved word or a construction the compiler couldn't turn into "object" code. This wasn't the only process: once you'd corrected all the things the compiler had flagged, you took the resulting object file and gave it to the Linker. This looked up any external references, of which there were always lots in a generally useful VAX program, made sure you were using them in the right way and then turned your object file into machine code and stored it in a file whose name ended with .exe.

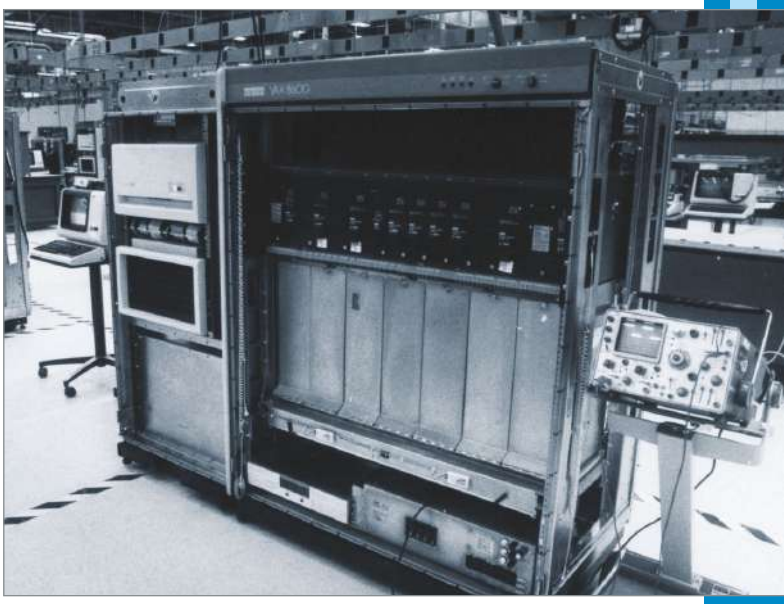
Modern coding is not really that different, other than being streamlined and automated for the most common use cases and coding standards. We tend to have a somewhat patchy appreciation for what our code is and how it works. Everyone makes a fuss about repositories such as GitHub, which are concerned mostly with version retention and backup of original code; very little is said about the ability to look at code not just for flaws, but for the muddy footprints of the bad guys. Back in my early days, the mk1 human eyeball was all we had to spot errors in coding or well-known faults, leading to vulnerabilities.

## Turning it around

So, how does the history of code as a delivery mechanism relate to responding to ill-judged comments from members of the ruling elite?

I will grant you that the first step is more like a giant leap. Let's say you can get your software providers to supply code, not executables, and that you're then able to review that code for potential security holes and opportunities for an intruder, before passing it through the application-packaging process inside your IT estate. The objective of this process is to provide some of the accountability we are apparently rather short of in our profession: signing off a chunk of code you have nurse-maided through the final build processes is about as immediate and responsible as it gets.

I know what experienced front-liners would say to such an idea. They would point at some of those old NASA pictures of the coders for the moonshot that feature fat, fanfold paper stacks of their epic contributions to the project, and say that if those paper printouts looked like a lot of code, then they were just mere footnotes compared to the size of code listings associated with anything notable or substantial in modern day retail, website or infrastructure sectors. We're now wrestling with systems dependent on tens of millions of lines of code. The amount of time needed to manually review and then deploy such systems is staggering, and the outcome of trying to do this all manually is also not well understood. There will always be failures.



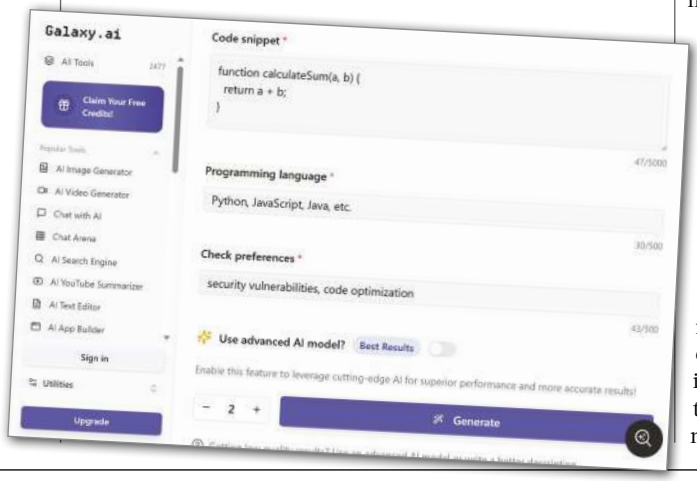
**ABOVE A VAX minicomputer, when "mini" meant the size of a railway locomotive**

**"We're now wrestling with systems dependent on tens of millions of lines of code"**

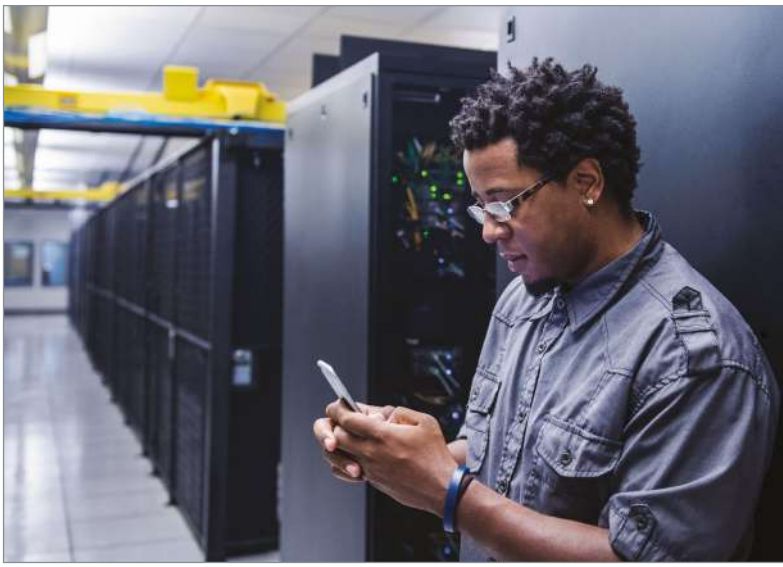
Enter Galaxy.ai. One of those services that might be a lot more complicated than we realise at first sight. It's a cut-'n'-paste service, allowing you to take representative bits of your site code and check them against a sample of AI models and code standard packages, looking for several classes of malfeasance or developer forgetfulness.

The principal advantage of a service like this, at this stage in the development of AI services, is that the computer can get through far more scenarios and language models than even the smartest IT guy could hope to accomplish. Most of us overthink the impact of AI, worrying about systems that are implausibly clever. Here's a case where raw speed confers enough of an advantage, with the cleverness simply being overgrown word-processor templates and a long-term project collecting coding rules, samples and AI models to examine them by.

But the very fact that Galaxy.ai even exists is proof that the code-level life of actual security measures is alive and well in 2025. As attacks of the scale seen by UK retailers intensify, along with public reaction to those attacks, we as a profession need to define some rules of




**BELOW Galaxy.ai is a great way to check code for malfeasance or forgetfulness**



engagement. Just being battered about by the ill-informed isn't a good way to speed up the resolution of a major hack, ransomware or malware outbreak. Let's look at a few of the strategies you can adopt.

**1. Nominated gatekeeper.** Tell your line manager that when there's a security problem in progress, his job is to keep the important, and the self-important, out of your office, the server room and any other technical asset locations. This is the stuff he's paid extra to do when the going gets tough, and yes, it can involve outbreaks of shouty-shouty. This will – or should – form a team bond between you and your management, and that's never be a bad thing.

**2. A bit of Theatre of Communications goes a long way.** Most of the IT nerds I know have a little chat room of their technical peers, in supplier businesses, even software houses and telcos. During an emergency, the natural behaviour is to keep your phone in your pocket and consult with your personal COBRA committee in low-key murmurs and terse texts.

I suggest you put up this support group on the biggest, brightest screens you can find, along with the most expensive and capable chatroom loudspeaker. Of course, this will feel uncomfortable to the commercial managers who want to pressurise you into the quickest fix, because they don't have a natural inclination to expose the business to external eyes and ears at its darkest time. Making the centre of operations a semi-public arena acknowledges the way that fixes or fightback options in ransomware and external bad-actor encounters are a collective endeavour, and that such a battle is no place for a shallow commercial agenda.

**3. Time is no longer money.** This is especially true in bigger web retailer businesses, where they know exactly how many pounds per minute they lose when things are not working as expected. There's no sense in the idea that money spent at any point in the life of the overall system might be the cure for an intruder's privations.

The classic example of this was the famous NHS worm, in which the downfall of the bad guys came when a low-paid, semi-casual researcher stumbled over a DNS name in the code of the worm that didn't have a live domain record out in the wild. He realised that the presence of that name on public DNSes was the "STOP" button for all the parts of the entire infection. The cost of trying that out was infinitesimal – almost embarrassingly tiny, given just how many gold-plated, high-powered security consulting firms were looking at the same calamity without having an inkling of the simplicity of the fix.

So look very carefully at apparent contributors who have expensive, complex, protracted or semi-secret magic-bullet tools they think you might sign up to at a time of maximum stress. With the possible exception of nation-state cyberwar operations, most attackers, hackers and data-nappers aren't spending large amounts of money to penetrate your network: this is a game that favours ingenuity and lateral thinking above deep pockets and hierarchical, command-driven battlefield manoeuvres. Critics of your approach drunk on the idea that it's a "war out there" are mostly doing the attacker's job for them, and need introducing to your nominated gatekeeper without further ado.

**4. Intrusions can take a long time.** Hundreds of days are not uncommon between the date of the first arrival and the date of the first actual damaging attack. Hackers take a long time to try to figure out what they have snagged themselves, and another long time to figure out the best way of making money out of an attack without destroying the tools they used to penetrate or, later, connect with the compromised host.

**ABOVE** Make sure you have a gatekeeper to your server room

**"During an emergency, consult with your personal COBRA committee"**

**BELOW** Dealing with an attack should be a team effort

When the boss turns up and tries to micromanage the last 48 hours, as if a door had been left unlocked by someone sloppy and undisciplined like you, this is the time to talk of the matter of long-lasting attacks, done by bad guys whose characters are completely at odds with the usual perception of the showy, anarchic, hacker stereotype. This is when I drop comments such as "big school" or "proper criminals" into the conversation – subjects that the angry micromanager type don't expect to be hearing from a computer person.

**5. Division of labour is absolutely vital to the speed of remediation.** When a disgruntled employee took a global luxury goods brand off the internet, the IT team changed character entirely in one 15-minute crisis meeting. Seven people in the room, one of whom was revealed as an undercover security consultant and the new, temporary head of IT as he worked out exactly where this threat and resulting outage had come from, which members of staff were involved, and what courses of action to take.

I'd like to detail how the firewall takeover was accomplished, but I wasn't in that server room at that instant. Instead, I was standing around in the principal company attorney's suite of rooms, figuring out how to re-register some 6,000 DNS domains for a whole slew of luxuries, absolutely none of which I can identify by name, even now.

Insights into how IT people behave when the going gets tough like this are the things that MP s don't get to see in the normal course of their duties. It's not entirely our job to rehabilitate them, but it is for us to understand how to minimise the damage they can do, right in the middle of a crisis.

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# Enter the Dragon

**LEFT** **The Dragon 32 was a striking-looking machine with a Motorola 6809E processor**

## It entered with a roar and left with barely any fire in its belly, but there's no doubt Dragon's computers ought to be celebrated, as David Crookes explains

Playground wars centred around 8-bit computers were commonplace in the 1980s. One side comprised those who would hear no wrong about their beloved ZX Spectrums. The other side supported the Commodore 64. And both seldom found common ground, except for a mutual disdain of those who owned an Amstrad CPC 464.

But there was also a group of kids who didn't even get that reaction – a small number whose parents bought computers made by Dragon Data. There was no pity, no laughter, just a shrug. And that was because the machine came and went so quickly it barely had time to ignite its fire, never mind burn rivals that arrived before and after it.

Yet to ignore the Dragon 32 and its successor the Dragon 64 overlooks an important part of Britain's computing history. For these machines, created in Wales, were technically great and, with more luck and a sounder financial footing, the company behind them could easily have made a huge impact on the tech industry.

That was certainly the aim of Tony Clarke, an enthusiastic and successful businessman who, as managing director at a Swansea-based toy company called Mettoy, had spotted the potential offered by the fledgling home computer market.

Mettoy was best known for making Corgi die-cast models, but Clarke sensed that the toy industry was set to suffer as children, particularly those over the age of nine, began to favour electronic goods. Clarke's background as a management consultant and electrical engineer put him in a good position to exploit a new opportunity, and he believed Mettoy had a distinct advantage over its rivals.

"Mettoy is a strange animal," he told *Popular Computing Weekly* in November 1982. "It has enormous resources – machine tool making, plastic moulding, high-volume manufacturing capacity and marketing skills. All the things in fact that infant computer manufacturers lack."

Even so, Clarke – who enlisted the help of an ex-Mettoy employer called Gerry Quick – still needed to work hard to persuade Mettoy's board to take the leap, and he did so in the best possible way, by taking them to the Personal Computer World Show trade fair in London in 1981. The company's top brass could see hundreds of children were attracted to the bright lights and potential of computers, so they gave Clarke the go-ahead to build a prototype.

### Burning ambition

It was created by a Cambridge-based consultancy called PA Technology. Ian Thompson-Bell was the firm's product engineering group manager and took charge of the new project. "Tony Clarke had a very clear idea of where he wanted to go and how to get there," Thompson-Bell told *PC Pro*.

"He explained that home computers had seriously eroded the market for die-cast toys among older children and he needed a product that played to Mettoy's strengths to fill the gap and he needed it fast. The Dragon 16 was to be that product."

One of the first decisions was to select the chip that would be at the heart of the new computer. As Clarke told *Popular Computing Weekly*, the firm had the pick of microprocessors and it eschewed the Zilog Z80 used by Sinclair and MOS Technology 6502 used by Commodore, Acorn, Atari and Apple in favour of the Motorola 6809.

This wasn't a cheap chip – it cost between four and six times that of the aforementioned 8-bit processors – but it was advanced and offered some 16-bit features. It also had support chips: the 6847 video controller and the 6883 Synchronous Address Multiplexer (SAM). It made the job of creating a computer simpler because it pretty much covered all bases.

But Mettoy wasn't alone in using this set of chips. The Tandy

**BELOW** **Mettoy spent a lot of time sourcing software for the Dragon 32**

At last.
A range of software that's as well designed as the Dragon 32.

SOFTWARE TO MATCH

THE FIRST FAMILY COMPUTER

DRAGON 32

DRAGON 32
The first family computer

Images: By Liftarn, Editing by: Bill Bertram (Pixel8), CC BY-SA 2.0, Wikimedia Commons

TRS-80 Color Computer, launched in 1980 and known as CoCo, did as well.

"Tony must have already been in contact with Motorola because he brought the SAM chip application note with him to the first meeting," explained Thompson-Bell. "It turned out that the application note was almost identical to the Tandy CoCo computer schematic. He wanted a European version of the Tandy with a better-quality keyboard and for it to be compatible with the CoCo's cartridges."

## Cutting costs

Given the changing face of the toy industry, a lot was riding on the Dragon 16, not least since Mettoy had had a financial deficit of £5.9 million over the preceding two years. "The Dragon was to be its saviour," Thompson-Bell said.

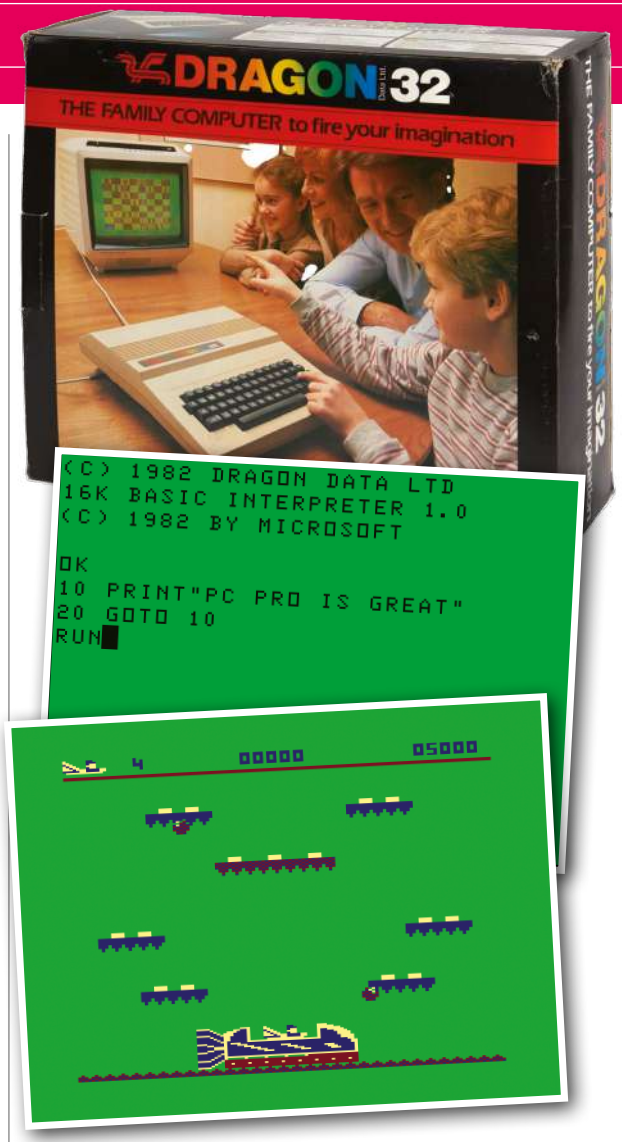
Yet time was tight because, to be successful and to generate money, the company's bosses knew they couldn't fall behind their established rivals, the likes of Acorn, Sinclair and Commodore. "Our first meeting was in October 1981 and the first prototype had to be demonstrated to the Mettoy board by that Christmas," said Thompson-Bell. "This necessitated us thrashing out some basic parameters and sharing of work."

Although the computer was going to use off-the-shelf designs and components, creating the Dragon 16 was very much an uphill task. There were so many different things to consider, such as the differing TV standards in the target European market and the different types of keyboards required by various countries.

To resolve such issues, the power supply and TV interface was split on to a separate, single-sided PCB, and that meant customising the computer for different countries would only entail making changes to this board. "For similar reasons, the keyboard was a separate bought-in item that could be made country-specific," Thompson-Bell said.

The Dragon 16 also required a printer interface, a tape cassette interface and two joystick inputs. "The Coco had an RS232 serial printer interface, and Tony wanted a parallel one," Thompson-Bell explained. "We made it parallel simply by adding a buffer to the keyboard drive bus. We also changed the joystick interface to a true analogue one by using the cassette DAC and a comparator as a simple ADC."

The most difficult part by far, however, was adapting the 6847 video chip, which was designed for the North American NTSC analogue colour television standard.




"We needed to produce 625-line European-style video rather than the 525-line US standard it was designed for," Thompson-Bell said.

"At that time, the only other video chip we might have used was the 6845. This would easily have solved all the timing issues with the different TV standards, but unfortunately its graphics and colour capabilities were very limited. If the timescale had been longer we would almost certainly have used an ASIC, but nobody could turn round an ASIC in the timescale so we had to do the job entirely with discreet logic."

While the PA Technology team worked on the innards, Mettoy concentrated on the computer's case. "We had to work very closely together right from the start to nail down PCB sizes, locations, fixings and the placement of connectors so Mettoy could create the injection moulding tooling," said Thompson-Bell.

"Fortunately it all turned out okay. The first time we assembled our PCBs and the keyboard into Mettoy's case, the PCBs fitted exactly and the connectors all poked out exactly where they were supposed to."

**TOP** **The computer was aimed at kids but marketed as the first family computer**

**MIDDLE** **You could also write your own programs in BASIC**

**ABOVE** **Hundreds of games were created for the Dragon 32, including Microdeal's *Cuthbert in Space***

**It's worth remembering that, in 1982, 16K was a lot of memory**

That's not to say there weren't more challenges, among them Clarke's determination that production would be as Welsh as possible. "We had to engineer for production and select a manufacturer so I spent a very pleasant few days with Mettoy's manufacturing director meeting with several contract manufacturers in Wales, discussing the Dragon project with them and touring their facilities," Thompson-Bell said.

"Although the Dragon was not expected to launch until August 1982, it had to be production-ready and available in quantity two months prior in order for Mettoy to be able to convince major stores such as Dixons to take it and also to prepare all the promotional material."

Thompson-Bell said that, shortly after, Clarke brought Derek Williams on board as technical director to both manage the subcontract manufacturer and set up in-house test facilities for ensuring product quality. Williams also ensured there was a wide range of available software to run on the Dragon. "This freed us up to start work on variants like the Secam version, and the composite monitor version," Thompson-Bell added.

But then, on 23 April 1982, just two weeks before the team was due to commit to volume production of the PCBs, Sinclair launched the ZX Spectrum with its 16K basic version and enhanced 48K variant.

"No way was Tony going to be outdone by Sinclair so, in an instant, the Dragon 16 became the Dragon 32 and we had to make it happen in two weeks," Thompson-Bell said. This was achieved by adding a daughterboard to give another 16K.

"It's worth remembering that, in 1982, 16K was a lot of memory and it was expensive," Thompson-Bell recalls. "Most computers before that had much smaller RAM sizes. Even the IBM PC, when it was first launched in August 1981, had only 16K of memory. I don't think anyone quite realised at the time just how rapidly this was going to change."

## Fire fight

Still, efforts were made to be one step ahead. The development team chose Microsoft Extended BASIC as the operating system and, since the PA Technology team was contracted only to design the electronics hardware, the BIOS was worked on by Motorola microprocessor expert Duncan Smeed from the department of computer science at the University of Strathclyde in Scotland.

"Mettoy decided very early on to license Microsoft BASIC for the Dragon, but Microsoft only provided software hooks to the peripherals," Thompson-Bell said. "That was when Duncan was brought in by Mettoy to write the drivers for them." Smeed's work, in combination with that of PA Technology, enhanced the computer to a great degree.

"When Duncan and I first tried out the prototype Dragon we were disappointed by how slow the BASIC interpreter seemed to run," Thompson-Bell said. "After further analysis, we discovered a significant amount of time was spent in the keyboard scan routines looking for specific important keys like Break.

"Of course, most of the time no keys are pressed so this really is dead time. The solution was to begin the scan routine by checking if any key had been depressed. As the keyboard is arranged in rows and columns, the usual scan routing enables one column and reads in the entire row (eight keys worth) and then moves on to the next column until the whole keyboard has been scanned. But we didn't care *which* key had been pressed. We only initially wanted to know if *any* key had been pressed.

"So we simply enabled all eight columns at once and read in the rows. If you got a one in any row you knew a key had been pressed. If not, you could exit immediately. This meant most of the time the keyboard routine ran eight times faster than before."

## Scaling up

The aim was to sell 10,000 units by Christmas, but that turned out to be a conservative estimate. Although in November 1982 Mettoy had sold the Dragon project to a consortium while keeping an 19% stake in the newly formed Dragon Data, the company had still managed to drum up a lot of interest among retailers, notably Dixons and Boots. To that end, the computer sold four times that number and, by June 1983, Boots was expressing great happiness at having the Dragon 32 on sale.

Anton Boyles, responsible for organising Boots' home computer sales, told issue two of *Dragon User* magazine: "It would be an underestimate to say that we are tremendously pleased with the Dragon." He said the Dragon was doing so well because it was "effectively a finished product" with a large memory and high-quality graphics. A figure for February 1983 suggested sales of 55,000, with Boots accounting for a third.

"I think selling it through major retailers like Dixons contributed a lot to its success – that and its business-like build quality and keyboard, which set it apart from its flimsier competition," Thompson-Bell said. "You could sit a small Sony monitor on top of a Dragon. Try that with a ZX Spectrum! I remember walking past Dixons and seeing the Dragon, my creation, in the shop window. That was a very special feeling."

## The new product had to be light years ahead of the Dragon 32

Rather than rest on their laurels, plans were drawn up for a disc-operating system and a machine with a built-in monitor and tape player along with a networking system. "By late 1982 we were working on the design disc drive cartridge," Thompson-Bell said. "This was going to bring the OS/9 operating system to the Dragon, and we had already been in discussion with Ken Kaplan of Microware, who wrote much of OS/9."

## And puff!

Thing appeared to be looking up. An initial lack of software subsided and developers were enthusiastic. Game creator Philip Oliver, well known for the *Dizzy* series, said he'd chosen the Dragon 32 because it had colour graphics, a decent keyboard and more memory than many of its competitors.

"We were especially drawn to its unique commands for drawing graphics and manipulating screen elements, like the simple 'GET' and 'PUT' commands that allowed you to move graphic blocks around," Oliver said. "Just what was needed for aspiring game developers – fantastically intuitive and fun."

**BELOW Just two ports and an on/off switch adorned the back of the computer**

**BOTTOM The Dragon 32 was also blessed with the 8-bit classic *Jet Set Willy***

There was also enthusiasm for the new UNIX-like operating system aimed at the professional market. "PA Technology was contracted to develop the next-generation product," said Thompson-Bell. "I ran the project, which was named after the star system Draconis because the new product had to be light years ahead of the Dragon 32. The processor was to be the 32-bit Motorola 68020 with 1MB of RAM married to the highly capable NEC uPD7220 Graphics Display Controller, which would have blown the IBM PC's clunky CGA graphics out of the water."

But expenses were rising, revenue was falling and the company's commitment to spreading its wings was causing difficulties. Dragon Data was handed £2.5 million from shareholders but the company was in a state of flux. Clarke made a big decision and departed, prompting the electronics giant GEC to take control and appoint a new managing director. It was the beginning of the end.

"Dragon Data suddenly became rudderless with the unexpected departure of Tony Clarke," said Thompson-Bell. "To me, Tony was a visionary, and we spent a lot of time discussing the future of the home computer industry. Unfortunately the rapidity of the Dragon 32's success, the lack of adequate funding and the sheer effort required to keep Dragon Data functioning was, I think, in the end too much for Tony and for his own sanity he had no choice but to walk away."

It didn't help that the Dragon 32's successor, the Dragon 64 – released in August 1983 – received a lukewarm reception, critics calling it out for not being wildly different to the first. As a consequence, following falling sales into 1984, Dragon Data called in the receivers and, while a Spanish firm called Eurohard SA took the reins and released a rebranded Dragon 64 as the Dragon 200 for the Spanish and Latin American markets, it was too little, too late. The Dragon had been slayed.

Despite that, the computer remained an enthusiast favourite for years – *Dragon User* magazine continued until 1989. Thompson-Bell says this was likely due to it having the "best 8-bit microprocessor ever conceived, coupled with a proper keyboard housed in something that didn't look like it would fall to pieces if you dropped it on the floor".

And he ponders what may have been had history been kinder. "If Dragon Data had not had its financial burdens," he said, "I sometimes wonder if we would not all be sitting at the latest Dragon computer rather than a PC."

**Images:** By Liftarn. Editing by: Bill Bertram (Pixel8), CC BY-SA 2.0, Wikimedia Commons By Miguel Durán, CC BY-SA 2.5, Wikimedia Commons

# Futures

# What idioms teach us about AI and its evolution

**Research into how AI interprets idioms into images and text reveals a lot about the technology – and us, finds Nicole Kobie**

Counting the instances of the letter "r" in "strawberry". Generating an image to show kicking the bucket, monkey business or another idiom – or *no* elephants in a room. These are all examples of viral pranks played on large language models (LLMs), and they reveal plenty about how these systems work, when they don't and how they're slowly getting better.

When it comes to idioms, LLMs perform much better when sticking with text than they do with images. Ask ChatGPT et al to explain a phrase in text, and you're likely to receive a detailed and even accurate answer.

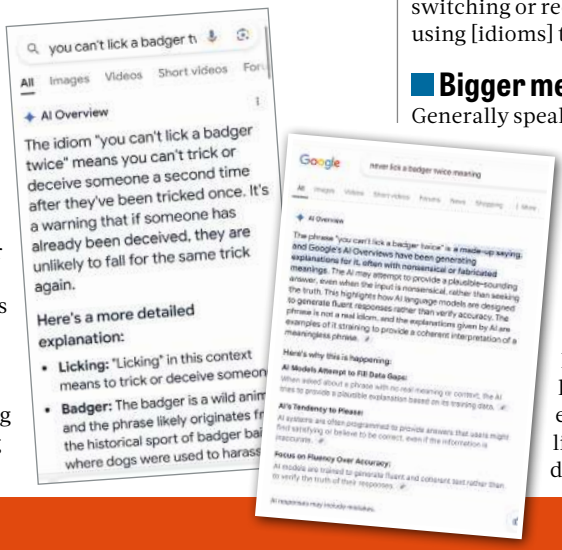
But it's still possible to trick AI by making up idioms. On social media, one suggestion was: "You can't lick a badger twice." It felt real enough to fool Google's AI Overview (see "Make your own idiom", p28), but ChatGPT 4o returns a more sensible result, saying it's not a common phrase, suggesting a few potential meanings from similar idioms and asking for more information, which is as close as these LLMs get to saying they don't know.

## Understanding LLMs

Tom Pickard, a researcher at the University of Sheffield, studies how AI manages idioms, in part to help develop systems that are better at deciphering the weird figures of speech created by humans. It turns out that idioms are a great way to help people understand how LLMs work, and why they sometimes don't.

That really comes down to the fact that these systems don't "understand" our language. In fact, they rip it apart, reducing words and letters into tokens devoid of any meaning. "The tokens, the words are broken up in training, it doesn't process text, it processes multi-dimensional vectors and numbers," Pickard said at the Turing Institute's AI conference.

Now, such examples are trickery on our behalf. We humans are trying to fool the AI into returning a silly result. Beyond creating fodder for social media posts or amusing articles on technology sites, this does have a real purpose: we can learn how LLMs work, or don't. Doing so in an entertaining way is a bonus.


you can't lick a badger tw
All
Images
Videos
Short videos
AI Overview
The idiom "you can't lick a badger twice" means you can't trick or deceive someone a second time after they've been tricked once. It's a warning that if someone has already been deceived, they are unlikely to fall for the same trick again.
Here's a more detailed explanation:
Licking: "Licking" in this context means to trick or deceive someon
Badger: The badger is a wild anim
and the phrase likely originates fr
the historical sport of badger ba
where dogs were used to harass
Google

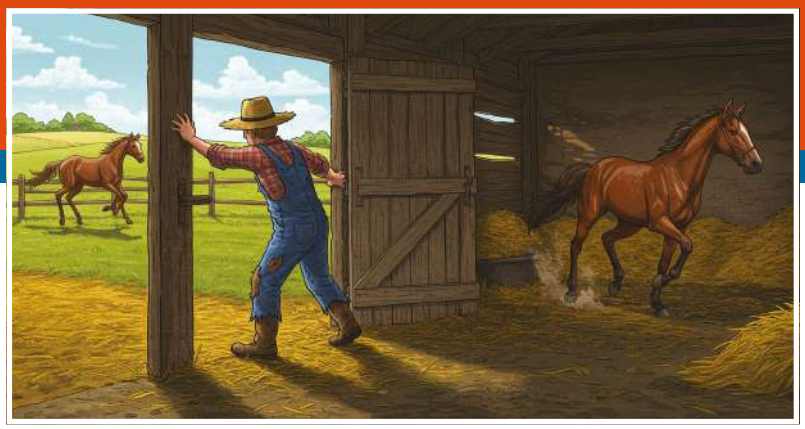
**BELOW That well-known idiom "you can't lick a badger twice"**

As Pickard notes, the success of "pranks" such as asking Google's AI Overviews about licking badgers comes down to the fact that computer scientists and engineers didn't consider that people would try to trick their tools. "If you talk to Siri or the Google voice-activated tech and put on a silly voice or an exaggerated accent it may not recognise what you're saying very well," he told me. "To an extent this doesn't really matter and there are more important edge-cases to focus on – if the tool doesn't recognise your actual accent or speech patterns, pick up on you code-switching or recognise that you're using [idioms] that's a bigger deal."

## Bigger means better?

Generally speaking, the belief is that LLMs will get better as they get bigger. That does apply to idioms, but it's not as straightforward as it may seem, Pickard notes.

"My colleagues and I have a paper from last year where we explored using LLMs like ChatGPT for idiom detection and they do



**ABOVE Shutting the stable door after the horse bolted, as imagined by AI**

get better with size, but they don't keep up with humans or with smaller models which have been tuned to this particular task," he said.

More recent models, including DeepSeek, have included a technique called reasoning that has improved outputs without having to necessarily build ever bigger LLMs, although they're still pretty huge. But that technique doesn't always improve idioms, either.

"The model needs to be able to produce an accurate definition of an idiom before it can 'reason' about whether that definition applies in a particular context," Pickard explained.

He points to how humans unpick a strange phrase, perhaps saying in a meeting "shutting the stable door after the horse bolted". A colleague who had never heard that before would understand you weren't talking about farm animals, and probably be able to guess what you meant.

"That kind of meta-reasoning just isn't present in the AI outputs, and that doesn't surprise me at all, because what they're doing doesn't actually resemble reasoning in a meaningful sense – they're producing vaguely reasoning-shaped text, not actually thinking through a problem," he said. "It's fascinating that this process seems to increase the chance of them getting the right answer on lots of benchmarks, but I think it's a bit disingenuous to call it 'reasoning', and it doesn't appear to be helping them very much with idiom processing."

## Quick changes

Beyond idioms, there have been a few cases of LLM mix-ups going viral. In one early example, ChatGPT was asked how many instances of the letter "r" were in "strawberry" – and it simply couldn't accept there were three. In another, OpenAI's image generator DALL-E was asked to create an image of a room without an elephant, but every room prominently featured a pachyderm.

When such examples hit the headlines, the systems are often immediately tweaked to avoid such issues in the future.

"When these kinds of viral weaknesses are fixed rapidly, I'm pretty sure the developers are patching something in the interface layer rather than updating the models themselves," Pickard said. "You'll get a better answer now about the number of 'r's in 'strawberry' than you once did, not because something has fundamentally been changed about the input processing but because that interface either includes a kind of hard-coding, or maybe because some sort of module has been added to allow for input text to be analysed at the character level."

And that makes it hard to study this aspect of LLMs, though the nature of LLMs means variation is inherent in outputs. "All of this... makes these large, opaque systems pretty poor subjects for scientific study in a lot of ways," said Pickard. "If I publish something which says that a shiny new model is great at interpreting sarcasm, we don't know what it is that makes that model good at this task, and you're unlikely to be able to replicate my study because there'll be a new version in the meantime."

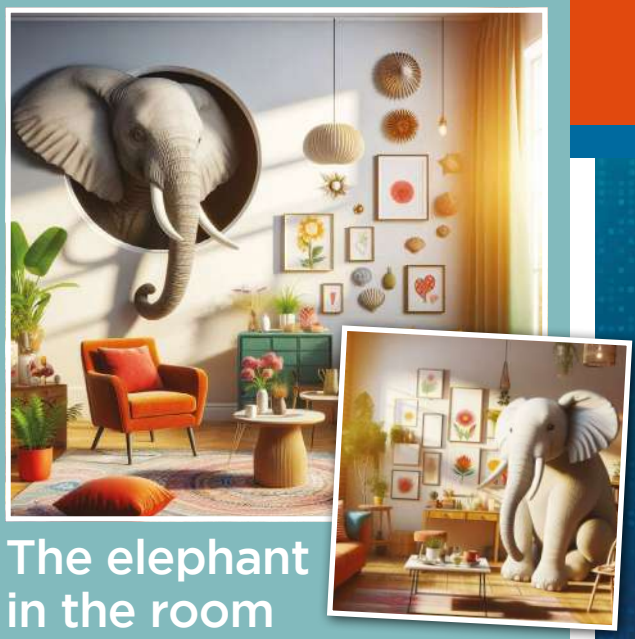
He added: "From a scientific point of view, I think we can do more by studying smaller, more specialised and openly available models, and then potentially have what we learn be applied to the larger systems."

Either way, that's some of the joy of getting to use these systems while they're being developed: we get to see the cracks and watch them get patched over. It's an education in how these systems work; someone new to LLMs even now may find it harder to spot flaws now they aren't as obvious.

**Generally speaking, the belief is that LLMs will get better as they get bigger**

## Why does it matter?

We need to know how LLMs work. Call it AI literacy, but in many ways it's an extension of digital or algorithmic understanding that many of us have failed to keep pace with over the past two decades.



## The elephant in the room

**Picture a room with no elephants. It's pretty easy for most of us – it's just any room, after all – but ask a LLM and the results tend to prominently include an elephant. Perhaps the pachyderm is peering in through a window, represented in a painting on the wall, or there's not one but two elephants.**

**What's happening? This reflects the fact that AI is trained by massive data sets, and when it comes to images the LLM relies on captions or labelling. A room with no elephant would simply be labelled as a room and wouldn't mention elephants in the caption. "It doesn't learn negative associations," said Pickard. "It learns to spot things that are mentioned in the caption."**

**This is a classic example, if there can be such a thing as a classic in toddler-aged technology. But here's where research in AI can be a challenge. Prompt ChatGPT for a room without an elephant, and it will spit out a classy but boring living room, with a few sofas and a coffee table, with no animals in sight. But ask Bing, which uses OpenAI's DALL-E 3, the most recent version of its image generation tool, and the room is once again full of elephants.**

Ten years ago, the *topic du jour* for tech ethics wasn't AI bias but the risk of algorithmic black boxes. Simply put, if we don't know how an algorithm comes to a "decision", we don't know when it makes mistakes or how to make them more accountable or accurate. It's simply numbers in, answers out.

AI, and in particular deep learning, exacerbates that because we don't really know what the systems are "thinking", for lack of a better word. We set these models loose on huge sets of data in order to "learn", but it's often not clear why an AI thinks that an image is of a dog rather than a wolf, a classic example in which researchers eventually understood that their model couldn't tell the animals apart, but organised them via their environmental surroundings, such as on a sofa inside or in the wilderness surrounded by snow.

Image: ?????????????

Image: ?????????????

That lack of understanding what the system is doing matters when we start to apply AI to everything from sifting through CVs for job applications to deciding who stays in prison or is released or powering the entire civil service, as the UK government hopes to achieve. "The UK government, for whatever reason, is 'betting the farm' on using generative AI, and I'm not sure they should be," Pickard said. "It doesn't understand things – and I think this is where it becomes quite important."

Now, AI could be helpful, but anyone using such systems – or having such systems used on them – should understand the limitations. For example, using AI to transcribe GP appointments or benefits interviews could be beneficial, but it may also trip up on figures of speech or confusingly phrased language. And that matters when English isn't your first language.

"My go-to example is to imagine a chatbot of some sort in a healthcare setting – maybe it's trying to do something similar to the NHS 111 phone line and triage less severe problems, point people to the right services," Pickard said. "If I phone up or open the chat window and tell it I'm feeling 'blue', I should probably be signposted to mental health resources rather than treated for hypoxia."

**ABOVE/LEFT The UK government is betting the farm on generative AI**

## We get to see the cracks and then watch them get patched over

And that's particularly important with other languages. "Translation is another good example – metaphors, idioms and other figurative language are some of the most challenging things for human translators to handle, and I think improving models' 'understanding' of them will lead to appreciably better automatic translations," he said.

Figuring out idioms and LLMs won't just help us understand AI better, it could help us understand each other better, too. ●

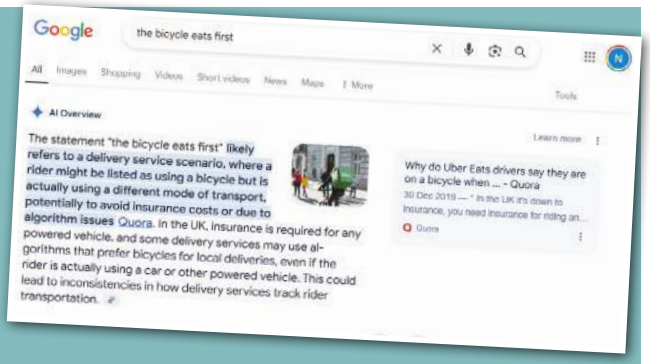
## Make your own idiom

Google's AI Overview – the one that pops up unasked for at the top of you search results – until recently had a funny quirk that sadly seems to have disappeared. (Perhaps AI developers should fix the disinformation rather than the fun stuff.)

Type in an idiom followed by "meaning" or "explained", and AI Overview will generate a miniature explainer for you – very handy for helping anyone from a different cultural or language background.

For example, try searching for "raining cats and dogs idiom meaning and sentence". At the time of writing, Google's AI Overview comes up with this: "The idiom 'raining cats and dogs' means it is raining very heavily. It's≈a figurative way to describe a downpour that is unusually intense. Sentence example: 'We had to cancel the picnic because it was raining cats and dogs.'"

But what happens if you make up an idiom? In a Threads post, author Meaghan Wilson Anastasios shared her attempt of "peanut butter platform heels". Google's AI Overview decided that was a "reference to a scientific experiment where peanut butter was used to demonstrate the creation of diamonds under high pressure". (It is not.)


Google
the bicycle eats first
All
Images
Shopping
Videos
Short videos
News
Maps
More
Tools
AI Overview
The statement "the bicycle eats first" likely refers to a delivery service scenario, where a rider might be listed as using a bicycle but is actually using a different mode of transport, potentially to avoid insurance costs or due to algorithm issues Quora. In the UK, insurance is required for any powered vehicle, and some delivery services may use algorithms that prefer bicycles for local deliveries, even if the rider is actually using a car or other powered vehicle. This could lead to inconsistencies in how delivery services track rider transportation.
Learn more
Why do Uber Eats drivers say they are on a bicycle when ... - Quora
30 Dec 2019 — In the UK it's down to insurance, you need insurance for riding an...
Quora

**RIGHT It's fun testing Google's AI with made-up idioms**

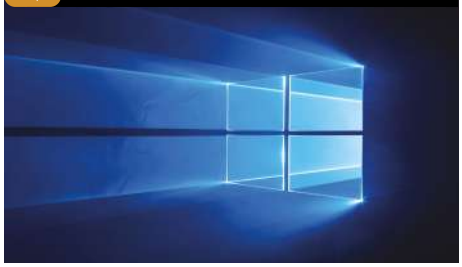
Other examples started doing the rounds, including "the bicycle eats first" (which apparently means you should prioritise nutrition when cycling or that food delivery services should prioritise using bicycles over cars or motorbikes) and "a loose dog won't surf", which AI Overview decided was a playful way of saying something isn't going to happen or work out. And then there's "never throw your poodle at a pig", which it interpreted as a humorous way of saying not to waste good things on someone who won't appreciate them. Apparently, it's derived from the biblical phrase about not casting pearls before swine.

Another that's popped up on social media is "you can't lick a badger twice", which AI Overview decided meant you can't trick someone a second time. But after the example phrase was included in a *Futurism* article, Google is now aware of it. The new AI-generated response says it's "a made-up saying, and Google's AI Overviews have been generating explanations for it, often with nonsensical or fabricated meanings". The response adds that this highlights how AI language models are "designed to generate fluent responses rather than verify accuracy". Indeed.

# PC PRO Next month

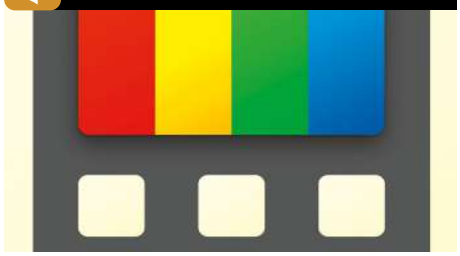
## ON SALE
Thursday 7 August

### Features



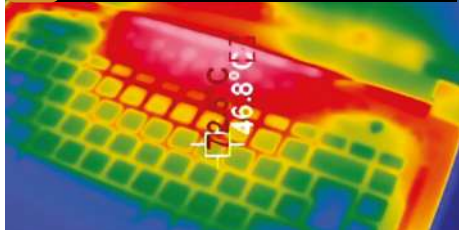
## Windows 10: the ultimatum
Lee Grant provides a step-by-step guide for anyone who's currently using a Windows 10 PC and needs to decide whether to stick, upgrade or switch.

### Features



## 10 Windows PowerToys you'll use every day
Discover the free add-ons that can speed up your workflow and make Windows behave the way you want.

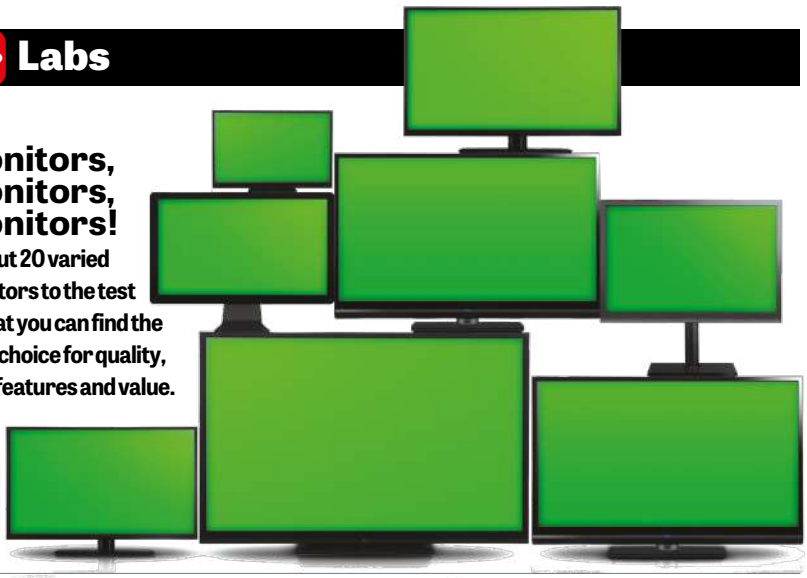
### Features



## Keeping your cool
Why is thermal management so important to modern devices, what's the best cooling strategy – and what are the risks if your devices overheat?

### Labs

## Monitors, monitors, monitors!
We put 20 varied monitors to the test so that you can find the ideal choice for quality, size, features and value.



### Retro

## Classic review: Amstrad PCW 8256
David Crookes has bought a second-hand PCW. How useful is it in today's world?

### The Network

## Protect your business with UTM appliances
SMBs are under attack more than ever before, but unified threat management devices may provide the best defence. Dave Mitchell explains what to look for.

### Futures

## What's next for mobility
Nicole provides insights from MOVE, the exhibition dedicated to reimagining how the world moves.

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Please note: Labs and features are subject to change

# Is gas running out on search engines, asks a perplexed Jon Honeyball?

One of the wonderful things about riding motorbikes is the camaraderie that comes with it. As the summer months roll in, there are almost nightly get-togethers that you can ride to, grab a bite to eat and natter with like-minded people, some of whom become friends over time.

Take Wicked Wheelie Wednesday, which happens every Wednesday night deep into the fens at Fendick's Fishery, a place for fishing enthusiasts. It's also home to a fine bar and a café that serves quite exceptional burgers. Leave home at 5pm, get there for 6, grab a burger and Coke, mooch around looking at the huge variety of bikes and still be home for 8pm. Just in time for a beer at the local pub with other friends.

A few weeks ago, I filled up my 2013 BMW R1200R bike at a petrol station en route. I was a little surprised at the bill of £36.14, which seemed high even though the tank was nearly empty. The pump said it was around 22 litres, and I only use E5 98RON fuel in my motorbikes. So that would be around £1.64 a litre; pricey but not outrageous. A friend was riding with me too, and mentioned later in the pub that his bill was also higher than he expected.

I have been playing with Perplexity AI and have a Pro subscription. I fired it up and asked, "What is the fuel tank size on a 2013 BMW R1200R motorbike?" It immediately replied: "The 2013 BMW R1200R motorbike has a fuel tank capacity of 18 litres (4.8 US gallons). This is confirmed across multiple reputable sources, including official manuals and motorcycle specification databases. Some sources also note a reserve fuel capacity of approximately 3 litres."

Ah, so there's a reserve too? I replied to Perplexity asking, "Does the 18 litres include the reserve?" It came back with, "Yes, the 18-litre total fuel capacity of the 2013 BMW R1200R includes the reserve. The reserve is approximately 3 litres, which means that when the low-fuel warning light comes on, there are about 3 litres remaining in the tank out of the total 18 litres."

I tried the same question using Google search. It could answer the first part if I waded through various advertisements and other dross but, of course, there was no means to ask the follow-up question.

So the fuel tank size is 18 litres and there was no way I could squeeze 22 litres in. Trading Standards queries are now handled by Citizens Advice, so I phoned and told them that I thought this petrol station was overclocking the fuel measurement on its pumps, especially the 98RON feed. Thanks for letting us know, came the reply, but naturally I've heard nothing since. Will others have reported it? My guess is that few would notice the difference on a partial fill-up, and the only reason I realised was that there was no way I was squeezing 22 litres into an 18-litre tank.

The star of this particular show, however, has been Perplexity. I have long felt that search engines have lost their shine. By which I mean that they have turned into a cesspit of sponsored placements and untrustworthy links that mean I find myself backing up to try another item from the list all too often. And all the while knowing that my choices and clicks are being monitored and monetised. Grubby doesn't even begin to describe the mess. Yes, there are better options than Google, and my preferred search engine has been DuckDuckGo, but even it has sponsored links at the top of its feed.

At the moment, the quality of response I am getting from Perplexity beats every conventional search engine every time. I like the reference links it provides me in an answer, which can take me back to the source documents. Links, incidentally, that appear to be high quality.

I fully expect the rot to set in at some point, and the quality of the answers to degrade. That is the way with all software over time. Stuff gets piled on, some of which might be useful and much of which isn't. Data mining kicks in with a vengeance, and then the advertising floodgates open. Maybe this won't be the case with AI search, especially the Pro versions, but I'm not holding my breath.

> "Search engines have lost their shine. By which I mean that they have turned into a cesspit of sponsored placements and untrustworthy links"

The bad news for Google et al is that, starting from today, I am using Perplexity to answer questions. Sure, a traditional search engine might still be the muscle memory method to finding the website of a particular company, but that's purely out of habit: I know that entering stream-of-consciousness text like "bmw motorrad dealer peterborough" into Google returns the correct information and the right URL links. But even that muscle memory will dwindle with time, especially when Perplexity allows me to follow up with "Do they serve coffee?" And its answer is correct, too.

I think the meteorite has just landed. And the dinosaurs are in deep danger.

**Jon Honeyball is a founding editor of *PC Pro*. The only time he looks good in leather is when he's roaring down an A road on a bike. Email jon@jonhoneyball.com**

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